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AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION

Multiple housing sweeps like a new broom across 80 acres of lower Manhattan as Metropolitan Life Insurance Co.'s Stuyvesant Town, partial view left foreground, and Peter Cooper Village, just beyond, right, are readied for bricking in. 11,300 apartments will be heated by a vacuum steam system supplied from district mains of the New York Steam Corp.

A Solar House Progress Report . . page 55

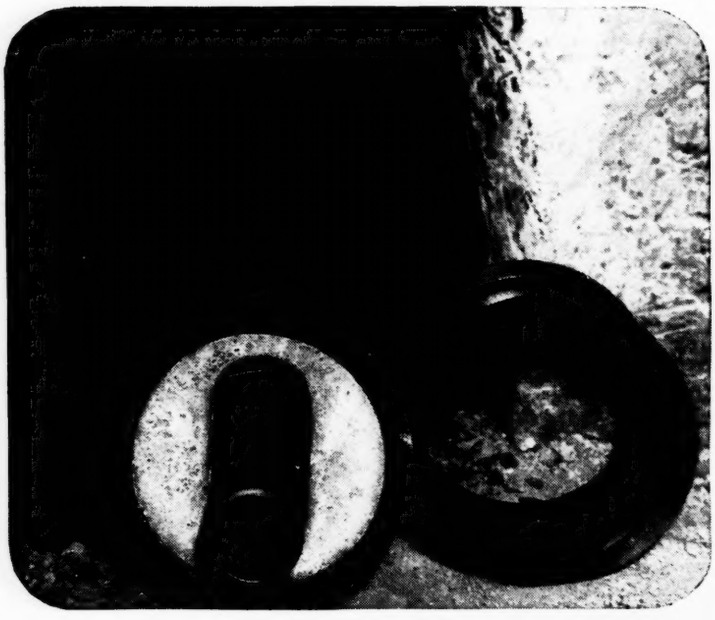
Electric Motor Starting and Control . page 60

Coil Selection and Heat Transfer Demand . page 65

How to Design Around Material Shortage . page 77

RIC-WIL CONDUIT MAKES IT POSSIBLE TO INSTALL STEAM LINE UNDER BUSY STREET — WHILE TRAFFIC MOVES AS USUAL

Special flanged prefabricated units 10' 6" long, arranged for lateral expansion, installed in tunnel.



● Ric-wiL prefabricated insulated units enabled the Toledo Edison Co. to carry out a truly modern method of installing underground pipe, without the necessity of tearing up street pavement from curb to curb. Instead of the tremendous expense and crippling confusion which are often involved in such projects, traffic proceeded normally on busy Jefferson St., almost completely unaware of the work in progress below. From a 6 ft. square excavation at the steam main, crews augered 26" x 36" tunnels both ways, welded Ric-wiL pre-sealed units together and jacked them through to building basements. This is a graphic demonstration of one of the many reasons why the words "Ric-wiL Prefabricated Conduit" appear with such constant regularity on engineering specifications sheets.

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THE RIC-WIL COMPANY • CLEVELAND, OHIO
AGENTS IN PRINCIPAL CITIES

VENTILATING

A MONTHLY MAGAZINE FOR ENGINEERS AND CONTRACTORS CONCERNED WITH THE DESIGN AND APPLICATION OF AIR CONDITIONING, REFRIGERATION, PIPING, AIR SANITATION, HEATING AND VENTILATION IN BUILDINGS

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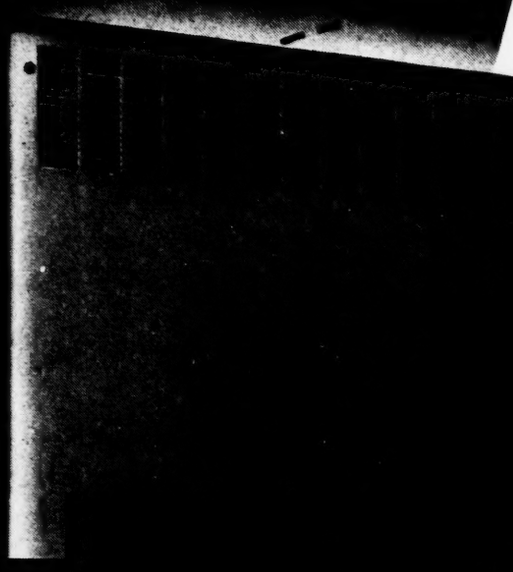
The INDUSTRIAL PRESS

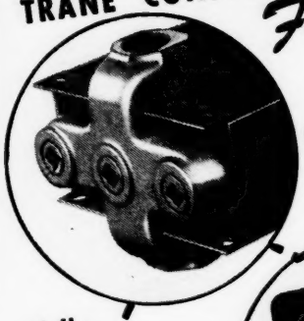
A NEW FEATURE THIS MONTH

In this issue a new feature begins—a monthly column by Tom Reyno'ds. Each month Mr. Reynolds will cover a variety of subjects among which is almost certain to be at least one of interest to you. Be sure to read this; it starts on page 80.

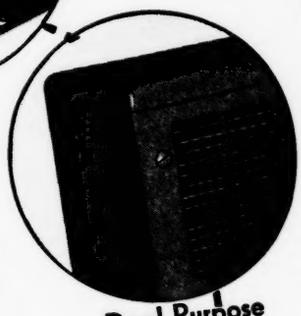
NOW..



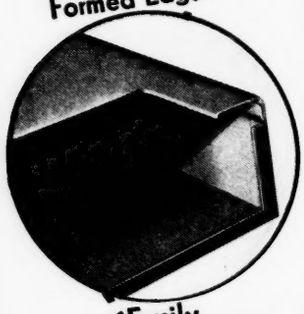
TRANE CONSTRUCTION *Features*



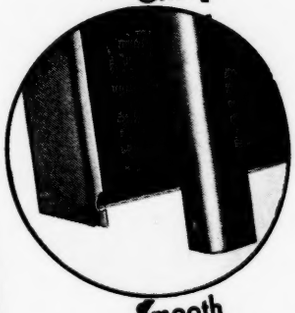
Trane Universal Coil



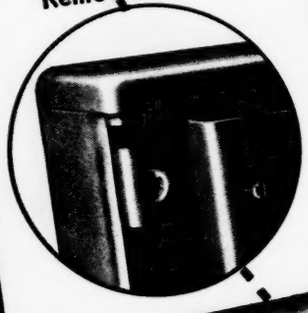
Carefully Formed Edges



Dual Purpose Grille



Easily Removable Front

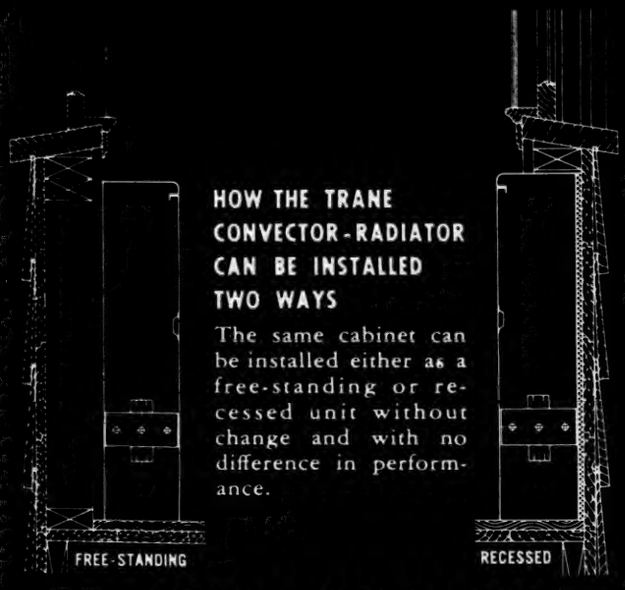


Smooth Offset Ends

FOOL-PROOF—Simplicity of design and construction makes this unit easy to install.

Here's what standard means:

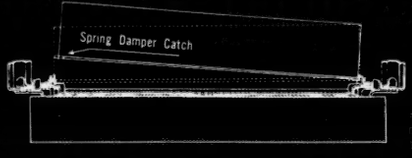
- 1 element for both steam and hot water.
- 1 cabinet style installed 2 ways.
- Sizes that fit most applications.



HOW THE TRANE CONVECTOR-RADIATOR CAN BE INSTALLED TWO WAYS

The same cabinet can be installed either as a free-standing or recessed unit without change and with no difference in performance.

HERE'S A *PLUS* FEATURE



Dampers for the positive control of head can be obtained and installed in two minutes without tools. Operated by an adjustable chain through the grill, these dampers give instant response without the use of valves.

Washington News

LORING F. OVERMAN

Take Time for a Change
Labor Leaders Wary
A Rent Formula – Maybe
Non-Housing Limit Raised

Among those who are not too familiar with the way Congress operates, there is doubtless a tendency to conclude that the new Republican-dominated set-up is to be as elephantine in its movements as is the pachyderm that symbolizes the Party. Basis for such a conclusion lies in the fact that nothing of great moment has been written into legal lore since Congress convened on January 3. No labor leglislation. No tax reduction. No budget cut. Nothing more exciting than the announcement of certain committee appointments and passage by both Houses of Congress of a bill permitting alcohol plants to make syrup as well!

It would be unfair, however, to conclude that there are not wheels in motion which will eventually grind out things of great interest to all whose welfare is dependent upon that of the heating, ventilating and air-conditioning industries. Just because a lot of things haven't come out of Congress is no sign that nothing has gone in!

In fact, it is doubtful if the new, streamlined and reduced-in-number Committees of the House and Senate were ever faced with such a grist of weighty matter. Until recently the "take a law" technique had been in effect throughout Congress, with more or less of a rubber stamp action expected in Committee sessions, and final approval by both Houses as a foregone conclusion. If Congress now seems to be making elephantine progress, it is perhaps because it remembers the most potent slogan of the 1946 elections: "Time for a Change."

This may be all to the good, for while the voters seemingly did authorize a "change", there appears to be plenty of room for differences of opinion concerning which changes will better conditions. It is in the committees that these differences of opinion are thrashed out. Interested citizens testify. Congressmen and Senators listen, inquire, try out their own ideas on the witnesses; temper their own conclusions in the light of evidence presented. When the public hearings are over, the Committee goes into executive session; endeavors to compose or compromise differences between its own members, and eventually brings to the floor of the House or Senate a measure representing the best collective judgment of its members.

At this point other members of Congress have their chance to discuss and amend, which they frequently do, often with results disastrous to the intent of the measure under consideration. This is particularly true when controversial measures are involved, as will be the case with labor leglislation, rent control, tax measures, the budget and similar subjects. For this reason, Committees considering such measures must come to the floor with their best efforts, and be prepared to defend them against all comers.

Such is the situation in Washington today. Every Congressional committee is concerned as never before with culling the wheat from the chaff, for each proposal is controversial because each represents a "change." Unfortunately, each committee must concern itself not only with the merits of the measure it is considering, but with its political aspects. Can it be passed in its present form? Could enough votes be mustered to override a possible veto? Could it be modified to make it more acceptable to those whose votes will be needed to pass it? And by no means least —how many voters will be pleased? Antagonized?

It is distasteful to many to realize that this latter consideration plays so important a part in slanting pending legislation, but after all, it was the voters who named the members of Congress. And it named them to voice the voters' preferences. Similarly, it is probable that in business circles, management slants its proposals and decisions with a weather eye on what will please the most influential members of the Board of Directors. Members of Congress, too, are only human.

So they are busy down in Washington, even though the President hasn't been called upon to wear out many pens signing new legislation. Tempers have cooled a bit since July 3, and the "new brooms" have been discarded in favor of the fact-finding suction of a legislative vacuum cleaner. While this method may not raise as much dust or turn up so much rubbish, there are many who find cause for concern in the apparent determination of committee members not to deviate too far from the election line, "Time for a Change".

Labor Leaders Wary

Comment in Washington during the closing week of February was to the effect that Senators weren't favorably impressed by their first efforts at "collective bargaining", with CIO President Philip Murray and AFL President William Green as witnesses before the Senate Labor Committee. The Senators are reported to have inquired politely of the labor leaders concerning their suggestions to restore harmony between management and labor.

Much to the surprise of the Senators, both labor leaders maintained stoutly that absolutely no change in labor laws is needed or acceptable to labor. Neither saw any need for any new rules concerning industry-wide bargaining, jurisdictional strikes or secondary boycotts—three points which management has said must be tempered to insure maximum production. Being of the opinion that collective bargaining usually involved certain compromise, members of the Senate Labor Committee had expected at least some counter proposals from Labor's top men. The fact that none was forthcoming did much to convince the Senators that management's complaints may not be unfounded.

If you've got a radiant-heating job to put in, use Rayduct — the steel pipe that's specially designed for radiant heating.

Made from special open-hearth steel, Rayduct is so ductile that you can easily bend it cold. It's pipe that's easy to weld, too.

Rayduct comes in sizes from ½ in. to 3 in., and in uniform 21 ft lengths, plus or minus 1 in. It's identified by a gold stripe running the length of the pipe. High in cost? Far from it! With all its advantages in radiant-heating installations, tough, cold-bending Rayduct sells for the same price as regular steel pipe.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation

Rayduct coils in radiant-heating system being installed in 16-story apartment building which the 15 East Ninety-first Street Corporation, a subsidiary of City Investing Company, is now building at the northwest corner of Madison Avenue and Ninety-first Street, New York City. All pipe bends were made cold. Heating Engineers: Slocum & Fuller. Heating Contractor: J. L. Murphy, Inc.

Rayduct

BETHLEHEM STEEL

FOR RADIANT HEATING

As a result, Washington observers are confidently predicting that there will indeed be corrective labor legislation this time, probably not until late in April, but something definite will offer constructive relief from current difficulties.

The House is letting the Senate carry the ball in the current labor legislation field, contending that the Senate has stymied all previous House efforts to apply correctives. The House would like to be on the receiving end this time, and its past record permits the conclusion that it can be depended upon for an assist. Sensing a Presidential veto of any labor legislation too drastic, the Senate will drive for something moderate.

"Portals" Closing

Mid-March is expected to see corrective legislation passed by both Houses to outlaw or limit many of the $5 billion worth of portal-to-portal pay suits pending under unique interpretations of the Wage-Hour Law. Placing of a one-year statute of limitations on wage-hour-overtime provisions of the Act is also likely, probably by means of a composite bill embodying features of four measures introduced in the Senate to cover the subject, and five in the House.

The fact that Labor Committees of the House and Senate must consolidate these nine separate measures designed to accomplish the same purpose, into one single bill acceptable to both Houses, explains why so much Committee activity must precede the appearance of important legislation on the floors.

Before the Senate Labor Committee alone, in addition to the portal-to-portal subjects, seven separate measures, each written by a different Senator, provide the basis for the hearings out of which the over-all labor-corrective legislation is expected to evolve.

All Quiet on Labor Front

In the meantime, wage negotiations in steel, autos and the electrical industry are marking time, letting Congress do the worrying for the moment. Rank-and-file workers must be enjoying the uninterrupted stream of paychecks for a change, and some hopefuls are predicting that labor leaders may have difficulty in selling the idea of more enforced vacations, sans pay. Silence from the John Lewis camp is also novel, but there are many who say it "could be" he will be brought out of hibernation as an even greater hero to his followers when the Supreme Court announces its decision concerning the Government's injunction against UMW.

Renters Also Vote

Observers recall that in the past he may have stretched the legal rope to its limits to reach the greener grass, but stretch was all. Should the Supreme Court decision reveal again how much the rope can be stretched, the result may be a personal victory for Lewis. On the other hand, it should halt any wavering on the part of Congress in its search for legislation less resilient.

While Congress appears to be losing its timidity in labor matters, Committees concerned continue to regard the proposal to raise rents as mighty hot to touch, Thousands of realty owners are screaming for relief, but millions of renters are shouting, "No." What is your guess as to the choice? Washington cynics say, "Rent legislation in two or three months, maybe—then a formula requiring individual applications and permitting increases of no more than 10%."

Action Pending

Things are strangely quiet in the Administrative Agencies that once exercised such great power over American business. Truth is that while Congress ponders budgets, personnel cuts and so on, many of these Agencies spend more of their time wondering whether the pink slip will be in the pay envelope instead of whether to launch new programs. And inevitably, anything done involves the lifting of restrictions rather than their imposition.

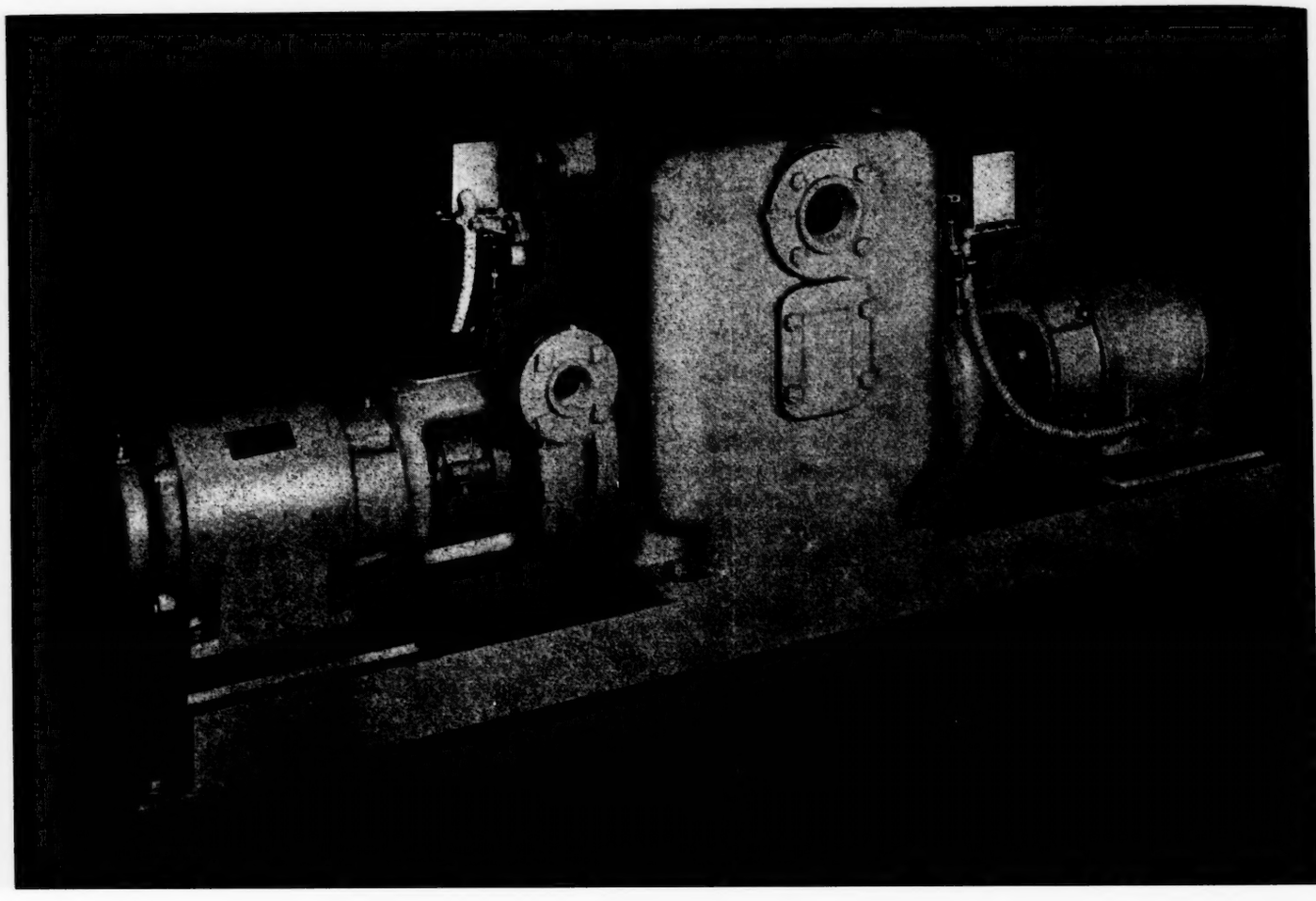
The Civilian Production Administration, for example, issued Direction 3 to Veterans Housing Program Order No. 1, to implement its previously-announced policy of raising non-housing construction to $50 million per week. Limit had been $30 million. The new Direction is of direct interest to the heating, ventilating and air-conditioning industry, for it gives the green light to a number of types of engineered projects previously forbidden. For those planning considerably ahead, the probability that all restrictions will be raised in September of this year will be of interest.

Under the new VH Program setup, even though projects may have been turned down in the past, they may now have a chance of securing approval, either on the grounds of essentiality, hardship, or evidence that the project would not interfere with housing.

Essentiality cases include facilities needed for the manufacture of critically short products listed by CPA, or for the manufacture of scarce building materials listed by the National Housing Administration; facilities to produce or preserve food products (but excluding frozen food locker plants except in special cases); facilities to produce farm machinery; and facilities vitally necessary to public health or safety, including certain community facilities if population has increased, primary and secondary schools, and facilities for veterans' educational programs; repair and maintenance where necessary to continue use of a building or to avoid serious injury to the structure; facilities to enable a veteran to go into business, provided the cost is less than $10,000.

New CPA rulings on *hardship cases* permit building to avoid hardship and stress if old facilities are lost through eviction, condemnation, disaster, etc.; if commitments have been made for the proposed job, such as purchasing materials and land during the period when no authorization was required; or if the proposed facilities will provide substantial employment in an area where unemployment is continuing and excessive. It should be noted that in all cases the hardship must be "substantial or exceedingly severe, such as threatened bankruptcy or substantial impairment of a means of livelihood."

MAXIMUM EFFICIENCY FOR STEAM HEATING SYSTEMS ON HEATING, DRYING AND PROCESS WORK.



JENNINGS CONDENSATION PUMPS

Designed for steam systems on heating, drying, or process work, these pumps offer the most reliable and efficient means of returning hot condensate to boiler or hot well. In many cases these pumps will save costly installation of boilers in a pit to provide gravity flow of returns from basement radiators and heating devices.

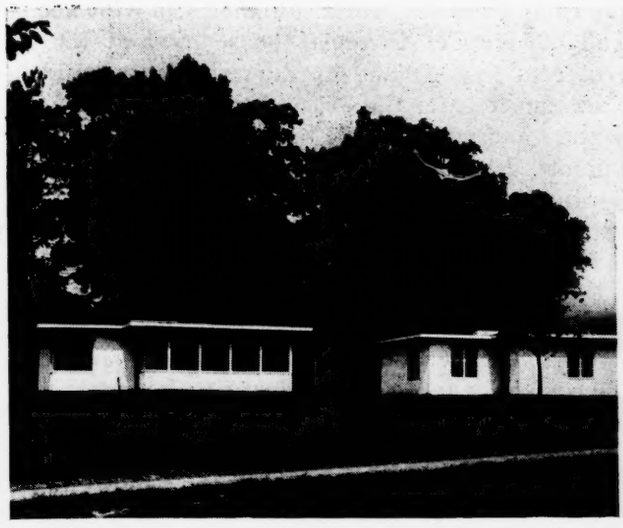
The Jennings Condensation Pumps are sturdy and compact in construction, and combine receiving tank, pump and driving motor in a single assembly. Pumps are bronze fitted throughout, with tobin bronze shaft. The pumping impeller is of special design, made possible by our wide experience with return line heating pumps, and is especially adapted for handling hot water with the greatest possible efficiency.

Full automatic control is furnished by means of a ball float and float switch mechanism mounted on the receiving tank. All wiring is made up at the factory, and it is necessary only to connect the pump to the system and hook up the leads. Complete information regarding these economical pumps sent promptly on request.

THE NASH ENGINEERING COMPANY

SOUTH NORWALK, CONNECTICUT, U. S. A.

HEATING AND VENTILATING



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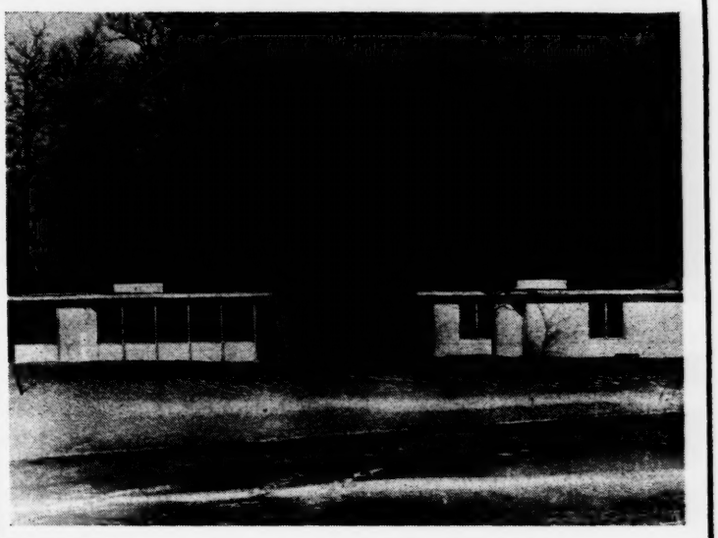

2

A Second Research Progress Report†

The Solar House

F. W. HUTCHINSON
Professor of Mechanical Engineering, Purdue University, Lafayette, Ind.

ONE year ago, in the March 1946 issue of HEATING AND VENTILATING, a first research progress report was published on the experimental work being conducted at Purdue University under a grant provided by the Libby-Owens-Ford Glass Company. This first report summarized results of a continuous nine-week test from December 1, 1945 to February 2, 1946 during which time the solar and non-solar test houses were unheated, but the inside air temperatures (and the outside air temperature) recorded. Average sunshine during the test period was 12¼%, average outside air temperature was 26F while average inside air temperatures for the two houses were 36F and 33.2F respectively. Thus the influence of solar energy was to reduce by 9% the degree-hours required for heating the solar house. It was emphasized, however, that "the houses do not have equal equivalent coefficients hence direct comparison of heating costs is not possible from the data which have been presented."

The present research report gives results for the same nine week test period one year later and with both houses electrically heated to a controlled inside temperature of 70F. Average sunshine during this period was 13.2%, average outside air temperature was 32.7F and energy requirements of the solar and non-solar houses were 2,924 and 2,514 kwh, respectively (See Table 1). Thus the solar house required 16.3% more energy than did the house of orthodox construction. The intent of this paper is to analyze the observed data and to seek interpretations which may be useful in assisting the engineer to estimate the performance solar houses of construction or exposure different from the one used in these tests.

Equipment and Procedure

The experimental houses which have been erected on the Purdue Housing Campus for the purposes of this project are shown in Fig. 1. The two houses were described in the previous report, so that it will suffice to recall that—with the exception of different glass areas—they are architecturally, structurally, and thermally similar. Glass areas on the north and west sides are the same for both houses, but the solar house has an excess of 71 square feet of glass on the south side and an excess of 16 square feet on the west side. All windows in both houses consist of two ¼-inch

†A technical paper prepared in cooperation with the Housing Research Division of the Purdue Research Foundation: G. Stanley Meikle, Research Director of the Foundation; Carl F. Boester, Housing Executive.

Table 1 — Weekly Averages for the 9 Week Test Period

Week of	Outside Air Temp., F	Energy Used, KWH		Hours of Sunshine
		Solar House	Orthodox House	
12/1/46-12/8/46	40.6	214	212	38.0
12/8/46-12/15/46	40.6	249	213	18.2
12/15/46-12/22/46	28.2	331	289	22.4
12/22/46-12/29/46	35.6	296	253	21.0
12/29/46-1/5/47	20.3	456	370	14.4
1/5/47-1/12/47	29.4	373	314	25.9
1/12/47-1/19/47	36.4	296	252	12.2
1/19/47-1/26/47	31.3	284	250	28.0
1/26/47-2/2/47	32.5	425	361	20.2
Overall average or total	32.7	2924	2514	200.3

sheets of clear glass separated by a ½ inch air space; the overall coefficient of heat transfer for the windows is .53 Btu per hr, per sq ft, per F, whereas the estimated overall coefficient for the walls (construction approximately that of Wall No. 61, ASHVE *Guide*, 1946, p. 128 is .08 Btu per hr, per sq ft, per F.

Fig. 1 (taken at solar noon in mid-winter) shows that the roof overhang does not exclude sunshine to any appreciable extent during the time of year covered by this report. Based on an hourly tabulation of shading effect for the nine week test period the irradiation factor (expressed as the fraction of window irradiated during periods of sunshine) is taken as .99. At solar noon in mid-summer the roof overhang is sufficient to place the entire window in the shade whereas in the spring and fall approximately one-half (see Fig. 2) of the south window is shaded. Two somewhat peculiar conditions exist in the solar house and each is difficult to precisely analyze: The west end of the south wall is set back in such a way that the adjacent west wall off-set shades the south glass during the early morning hours. Further, the west and south wall windows of the solar house meet at the corner (refer to Fig. 3) and during certain morning hours allow sun to enter the house through part of the south window and pass directly out through part of the west window. Neither of these conditions exists for a sufficiently large fraction of the irradiation time to constitute a major influence, but each serves to reduce the effectiveness of the solar construction.

Fig. 4 and 5, taken from the same relative position in each house, show the interior with location of the shielded temperature-sensitive control instruments and two of the four blower-type electric resistance heaters that are in service in each house. The blowers are in continuous operation (to maintain uniform circulation at all times) with resistance heating provided under thermostatic control; the four resistance elements cut on or off in sequence as called for by a modulating thermostat with relays. Solar intensity is determined by a pyrheliometer located on the roof of each house. Additional pyrheliometers are installed in the houses (see Fig. 4 and 5), but their readings are not used in this paper.

The photograph Fig. 5 shows partial covering of the floor of the solar house with a portable concrete slab. The slab was installed to investigate the influence of thermal capacity on regenerative use of solar irradiation and though the experimental work is now complete no report has as yet been issued. The added thermal resistance of the slab to heat losses through the floor has been taken account of in the calculations for this paper, but the slab effect is of no practical significance with respect to the results from the nine week heating test.

Analysis of Experimental Results

Since the two houses are thermally similar except for window area the analysis will be carried out by starting with the experimentally determined average rate of heat loss of the orthodox house and calculating

Table 2 — Solar Data for Average Day During Test Period

Time	Solar Altitude, Deg.	Azimuth, Deg.	Angle of Incidence, i, South Wall, Deg.	Cos i	Intensity, Btu per Sq Ft per Hour				
					Normal to Sun's Rays I_n	Vertical, South Window, Standard I_v	Vertical, South Window, on 12/25 I_v	Vertical, South Window, on 12/22 I_v	Vertical, South Window, on 12/31 I_v
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
8am	9	126	54	.5806	180	104.5	165.5	....	....
9am	14	138	44	.7210	224	161.3	174.0	36.0	144.0
10am	20	151	35	.8219	263	216.0	222.0	111.5	138.5
11am	24	165	28	.8823	276	243.2	261.5	130.5	209.0
12m	25	180	25	.9063	280	254.0	285.0	259.0	129.5
1pm	24	165	28	.8823	276	243.2	261.5	130.5	78.5
2pm	20	151	35	.8219	263	216.0	252.0	130.5	55.8
3pm	14	138	44	.7210	224	161.3	174.5	72.0	72.3
4pm	9	126	54	.5806	180	104.5	5.5	....	....
				Averages	....	189.8	180.2	124.3	116.8

Fig. 3. West and south wall of the Purdue solar house.

increments or decrements of heat loss that would be expected for the solar house. Since the total energy required for the orthodox house was 2514 kwh over a period of 63 days, it follows that the average rate of heat loss was $(2514 \times 3413) \div (63 \times 24) = 5690$ Btu per hour.

Energy losses from the solar house would be expected to differ from the foregoing value due to influence of the following factors:

1. Solar gain through the excess window areas in south and east walls.
2. Transmission losses through excess south and east wall windows.
3. Difference in degree-hours of heating for the two houses.

Each of these items will be given detailed consideration.

(1) *Solar Gain.* To evaluate the net energy gain through the excess glass area it is necessary to determine the (a) irradiation intensity on the outside of the window, (b) depletion of radiation due to reflection losses at the window, (c) reflection out through the windows of solar energy that has once entered the house, (d) excess transmission losses through interior surfaces which absorb solar energy, and (e) loss due to direct transmission *through* the house of solar energy (such as occurs at times through the south east corner).

The intensity of irradiation of the south window varies with season, with time of day and with weather. Hence the average irradiation rate during the nine week experimental period could only be obtained by integrating hourly values for each sunshine hour of each day of this period. As an approximation the average intensity can be evaluated for one representative day and this value used as a reasonably close (within 5%) average for the entire period. In a previous paper[1] a recommended curve was given for solar intensity in a plane normal to the sun's rays and as a function of month and of solar altitude. Table 2 gives the solar altitude, azimuth, angle of incidence on a south wall, cosine of the angle of incidence and the standard normal intensity, I_n, taken from the above-mentioned curve, all as functions of time for an average day of the nine week test period. Column 7 of Table 2 gives the vertical irradiation intensity, I_v, on a south window; the average value of I_v is seen to be 189.8 Btu per hr per sq ft and this figure— obtained by analysis—will be used as a basis for comparison with other values of I_v as developed from basic experimental data obtained on the research campus.

The horizontal component of solar intensity, I_h, was determined from a pyrheliometer record (the instrument being located on the roof of the solar house) for a clear (12/25/46) winter day. By dividing hourly values of I_h by the sine of the corresponding solar altitude (that is, by the cosine of the angle of incidence for a horizontal surface) and multiplying the result by the cosine of the angle of incidence for a vertical south window, the resultant hourly values of I_v are obtained and recorded in column 8 of Table 2; the average value of I_v for a *clear* day is seen to be 95% of the value indicated by the recommended curve. (The recommended curve was selected as a best general approximation for all parts of the United States which are near the line of 40° latitude; due to differing dust and water vapor contents all such localities would not have exactly the same normal intensities).

Similar pyrheliometer data for a typical day (12/22/46) of *scattered and intermittent sunshine* have been used, by the procedure described above, to obtain the vertical intensities as given in column 9 of Table 2; a similar pyrheliometer record for December 31, 1946 was used to obtain the I_v values given in col-

[1] "A Rational Basis for Solar Heating Analysis," F. W. Hutchinson and W. P. Chapman, ASHVE Journal Section, Heating, Piping and Air Conditioning, July, 1946.

Fig. 4. Interior of non-solar house showing control instruments.

umn 10. The average intensities for the days shown in columns 9 and 10 are seen to be 65.3% and 61.7% of the recommended intensity for a clear day. During the test period approximately two thirds of the recorded hours of sunshine were for times when the sky was partially cloudy and the sunshine intermittent; hence an approximate overall index of vertical intensity during the test can be obtained by averaging the three intensities given in columns 8, 9, and 10; thus, as an overall average, 74% of expected intensity was realized, and the 24 hour average irradiation rate on a south window (based on 9½ maximum possible hours of sunshine per day during the 63 day period) is (.74) $\times$ (189.8) $\times$ (9.5/24) $=$ 55.5 Btu per hr per sq ft). But sunshine was recorded for only 33.5% of the maximum possible hours; hence the actual 24-hour irradiation rate was .335 $\times$ 55.5 $=$ 18.6 Btu per hr per sq ft. Since there are 71 square feet of excess south wall glass the total irradiation rate is 71 $\times$ 18.6 $=$ 1320 Btu per hr on the south wall.

A similar analysis shows that the average irradiation on the east windows is approximately one third of that on the south; hence total east excess irradiation is (1/3) $\times$ (18.6) $\times$ (16) $=$ 99 Btu per hour. Total irradiation of excess solar house glass area is therefore 1320 $+$ 99 $=$ 1419 Btu per hr.

All of the energy striking the windows does not enter the house. By an analysis for each hour of the test period it can be established (method as given in reference 2) that 80% of the irradiation at the window is realized as an energy gain; hence .8 $\times$ 1419 $=$ 1135, and with a further 1% depletion due to shading from the roof overhang, the resultant energy reception within the structure is .99 $\times$ 1135 $=$ 1125 Btu per hr.

Although 1125 Btu per hr is received inside the house not all of this energy serves to reduce heating requirements. Part is reflected back out of the house without undergoing absorption while an additional fraction raises the inside surface temperature above the equilibrium value and thereby increases the transmission losses. The reflection fraction can be roughly evaluated by considering that—as is true in Fig. 4—the average irradiated area of floor starts 5 feet north of the south wall and is 9 feet deep; the length of this irradiated floor area will vary with time of day, but can conservatively be taken at an average value of 12 feet. The shape factor of a 5 $\times$ 12 ft window with respect to energy received from a 9 $\times$ 12 ft irradiated floor area (the relative positions of the two areas being as shown in the view on the cover) can be readily evaluated as slightly less than 6%; the shape factor of the remaining section of south window plus east and west windows (all with respect to the irradiated section of the floor) is likewise approximately 6% so that 12% of the reflected energy—assuming diffuse reflection—will leave in the direction of the windows. The emissivity of the floor with respect to solar radiation is roughly 60%, so that .6 $\times$ 12 $=$ .07 of the energy which enters the house is returned to the windows. If, as before, we take 20% as re-reflected from the windows, we then have .8 $\times$ .07 $=$ 5.6% of the solar energy which enters the house leaving again through the windows. Hence the balance is (1.00 $-$ .056) $\times$ 1125 $=$ 1,060 Btu per hr.

Of the above energy all is absorbed within the house, but not all provides a unit-for-unit reduction in heating requirements. A rough determination of the excess transmission loss through the floor can be obtained by setting up a heat balance on the irradiated floor section. Total absorbed energy divided by average irradiated floor area gives 1,060/108 $=$ 9.9 Btu per hr per sq ft as the surface heat source. Taking 2.1 as the floor film coefficient for combined transfer by radiation and convection and .08 as the conductance of the floor from the inside surface to the outside when based on the outside air temperature, a heat balance gives,

$$2.1\ (t_s - 70) + .08\ (t_s - 32.7) = 9.9$$

from which the floor inside surface temperature, t_s, can be evaluated as 73.5F and the consequent rate of transmission is .08 (73.5 $-$ 32.7) $=$ 3.26 Btu per hr per sq ft of irradiated floor surface, or 3.26 $\times$ 108 $=$ 352 Btu per hr. If this floor area were not irradiated the transmission loss would be .06 $\times$ 108 $\times$ (70 $-$ 32.7) $=$ 242 Btu per hr so that the net increase in

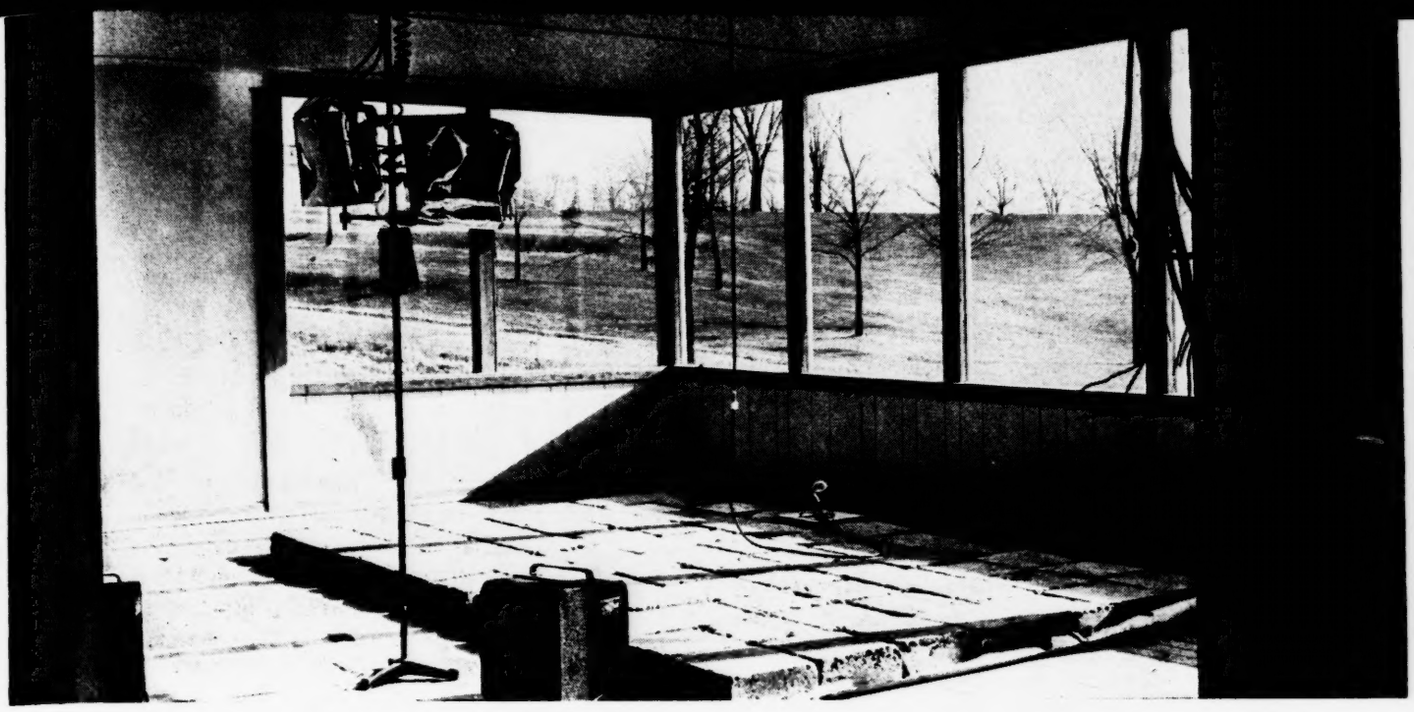

Fig. 5. View of interior of solar house from same relative angle as Fig. 4, but with concrete slabs on floor for tests on thermal capacity in connection with regenerative use of solar irradiation.

transmission losses is 352 — 242 = 110 Btu per hr. This represents a quantity of solar energy which enters the house, but is lost without contribution to the overall heating requirements. The net effective solar energy gain is therefore 1,060 — 1.10 = 950 Btu per hour.

(2) *Transmission losses through excess glass area.* The difference in overall coefficient between window and wall is .53 — .08 = .45, so that the excess transmission losses through the 71 sq ft of south excess and 16 sq ft of excess east glass amounts to .45 × 37.3 = 1460 Btu per hr.

(3) *Difference in degree-hour heating requirements.* Because of ineffective utilization of solar energy during periods of moderate outside temperature all of the energy received does not serve to reduce heating load. On two brief occasions the temperature within the orthodox house exceeded 70F by amounts sufficient to account for 40 degree-hours whereas 1440 degree-hours of extra heating were realized in the solar house. The 1400 degree-hour difference does not represent a true added load since it is not part of the useful heating effect, but in comparing total energy requirements of the two houses this many degree-hours must be added to the solar structures load. Degree-hour requirements of the orthodox house were 7 × 9 × 24 × 37.3 = 56,500 so the added energy required to account for the excess degree-hours of the solar house would be (1400/56,500) × (5690 + 1460) = 177 Btu per hr.

Summary. The sum of the excess transmission losses from items (2) and (3), above, less the gain from solar effect, item (1), gives the net calculated excess loss for the solar house as,

$$1460 + 177 - 950 = 687 \text{ Btu per hr}$$

or (687 × 24 × 63)/3413 = 304 kwh excess energy requirement for the nine week test period. Thus calculation shows an expected increased heating cost of 304/251 = 12.1% as compared with the actual increased cost of 16.3%. Assuming that the calculated values were accurate the departure of 4% from experimental results could easily be accounted for by the minor losses (through corners by direct transmission and due to shading of the south wall offset) which have been mentioned, but not evaluated. However, approximations used in the calculations are not sufficiently exact to justify consideration of a 4% difference and, in fact, it is more than probable that the relatively close correspondence is pleasantly fortuitous rather than technically satisfying.

Discussion

The results reported in this paper are for the most extreme nine week period of the heating season. As such they should be used with care since they are not necessarily representative of what would be found with a solar house of different construction, in a different locality, or considered over an entire heating season. The houses used in the research are unusually well insulated hence the solar house is at a definite disadvantage since the difference between the overall coefficients of heat transfer for the opaque wall and the window is substantially greater than it would be under conditions of average construction.

The season test, of which the data presented here are from only a part, started on September 16, 1946, and will continue without interruption to the end of the heating season. For the period from September 16, 1946, to December 1, 1946, the solar house showed a saving over heating requirements for the orthodox house of 7½% while the relative performance for the entire period from September 16, 1946 to February 18, 1947 shows a solar house loss of 9½%. Since the remaining part of the heating season will be characterized by milder weather than occurred during the nine week test period herein reported, it is highly probable that the excess energy requirements of the solar house will progressively decrease and it is not possible to predict which house will have the least seasonal heating cost. Overall results of the seven month heating season test will be reported as soon as they are available.

Motor Starting and Control

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To present the fundamentals and essentials of motor starting and control an effort is made to avoid as far as is possible all reference to the details of the many necessary gadgets used to accomplish protection sequence, timing or interlocking features. It is assumed that overload protection is recognized as highly desirable and will be incorporated in the apparatus when actually used. It is also assumed the choice of manual, semi-magnetic or full automatic operation will be dictated by the requirements of the application.

DIRECT current motors are characterized by the type winding, and are referred to as series, shunt or compound wound. In heating and ventilating work small series wound motors may be used with fans or blowers mounted on the rotor shaft. When using series wound motors the load must be direct coupled or geared and the use of belts is to be avoided as a loss of load will permit the rotor to increase in speed until it runs to destruction, due to centrifugal force.

Loads easy to start such as fans, blowers and centrifugal pumps of normal design are usually driven by shunt wound motors. Loads of heavy starting, such as compressors started loaded, are powered with compound wound motors.

Integral horsepower motor starters and controls 115 and 230-volt may be either manually or magnetically operated. Magnetic across-the-line starting of compound wound motors is usually limited to 1½ hp at 115-volt and 2 hp at 230-volt.

Fig. 1 is typical of the manually operated face plate or rheostat starter. Manual speed control apparatus is quite similar in appearance as illustrated by Fig. 2.

When connecting such a starter between the power source and the motor it will be found that motor lead identification corresponds to control terminal markings. For example, motor field leads F1 and F2 are to be connected to control terminals F1 and F2 respectively. Armature lead A1 to terminal A1. Motor lead S2 for a compound wound machine and F2 for a shunt wound machine to terminal L1.

A leaflet containing instructions for correctly hooking-up the motor and starter is supplied with each motor and with each starter. Terminal arrangement for a given direction of rotation is illustrated in the leaflet and as the motor lead and starter terminal identification are covered by NEMA standards, they are the same for all motors and starters regardless of manufacturer.

Shunt wound motors may be increased in operating speed by "field weakening." This is accomplished by inserting resistance in the field circuit. An increase in resistance will increase the motor speed. Should a change in load occur at a given speed, the speed will remain practically constant. Standard rheostats are designed for 50% speed increase for use with standard motors. However, motors and rheostats are available for speed range up to 4:1 or more.

Shunt and compound wound motors may be decreased in operating speed by inserting resistance in the armature circuit. An increase in resistance will cause a decrease in speed. Speed regulation by armature control is used in two classes of service, varying torque and constant torque. Varying torque services include fans, blowers, centrifugal pumps and similar equipment where the torque at half speed is approximately 35% of full load torque. Constant torque services include machine tool feed, plunger pumps and similar equipments where the horsepower output of the motor decreases directly with the speed while the torque is approximately constant. Torques at a given speed must remain constant if the motor speed is to be constant. Any fluctuation in the load means a corresponding variation in speed. Standard rheostats are designed for 50% speed reduction by armature control.

Where a combination of both armature and field

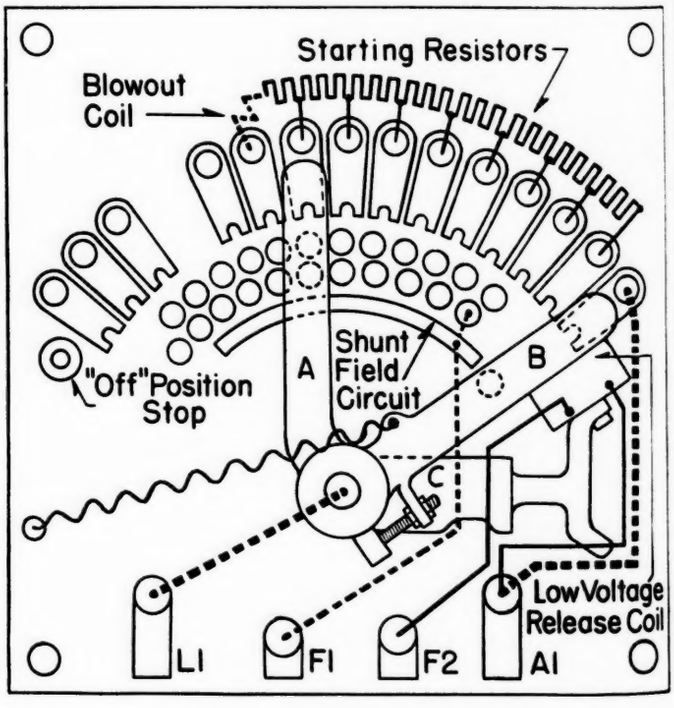


Fig. 1. Starting duty only.

The starting operation consists of moving the handle slowly all the way to the right or run position. During this operation, motor speed increases as starting resistors are progressively cut out until the motor is at full speed in the run position. Starter arm is held in this position by a magnet. To stop, move handle slowly all the way to the left or off position.

control is required, a shunt wound motor should be used.

Table 1 outlines standard apparatus as may be applied from manufacturers price forms.

A-C Motor Control – Polyphase

As typical power available for electric drives the standard 208-, 220-, 440- or 550-volt, 3-phase, 60-cycle current will be selected and apparatus discussed as applying there to. The simplest and least costly starter to use with a squirrel cage (constant speed) motor is the across-the-line type.

A manually operated knife switch (safety-switch) can be used as a starter for a motor of integral horsepower, but practice limits the maximum to 1 or 2 hp. This will not give protection to the motor against overload nor protect a line against short circuit. To gain some protection a double throw fused knife switch has possibilities. One side is fused heavy to withstand starting current and the other lightly fused to take running current only. To start, the switch is thrown so as to place the heavy fuses in the circuit as as soon as the load is up to speed the circuit is broken and quickly re-established thereby putting the light fuses in the line. To eliminate the inconvenience of double throw operation, a time delay type of fuse is available that withstands the reasonably high starting current of short duration but ruptures on a sustained overload of injurious proportions or short circuit. For a typical type C, 575-volt, a-c switch, see Fig. 3.

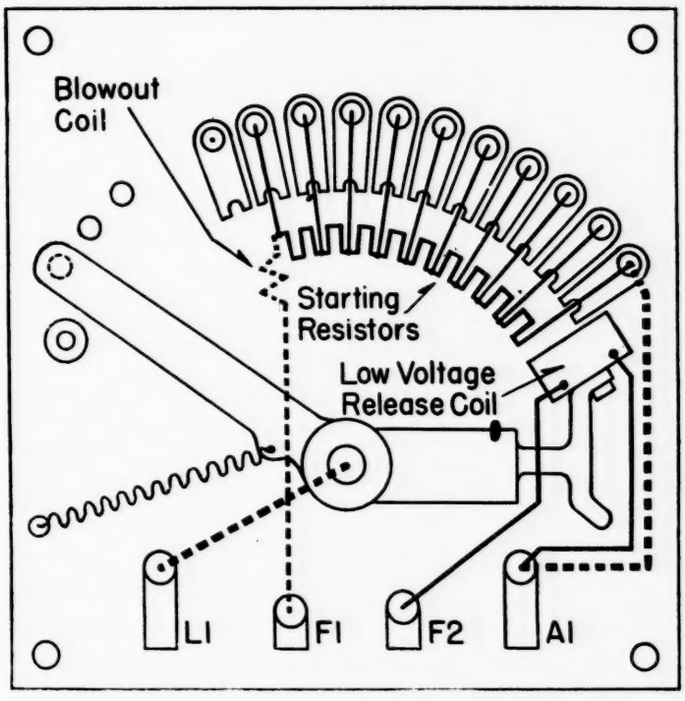


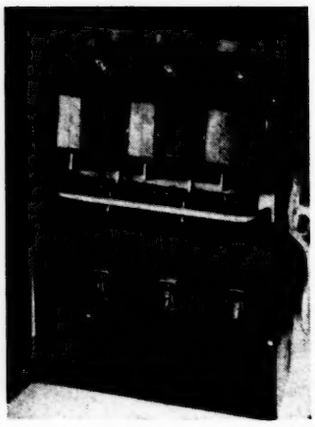
Fig. 2. Starting and regulating duty-field control.

Motor is started and brought to base speed the same as in Fig. 1. To increase speed, move handle to left which moves arm **A**, and cuts in field resistors connected to round buttons. Maximum speed is controlled by adjustment **C**. To stop, return handle to the off position.

Manual type starters are available that replace knife blades and jaws with small silver contacts and eliminate replaceable fuses by using thermal overload relays.

Table 1 – Standard Control for Direct Current Motors

Application	Method of Speed Control	Ratings		Description of Service
		115 Volts	230 Volts	
Starting only Motors Series Shunt or Compound Wound	None	Up to 25 hp	Up to 50 hp	100% torque on first point 5-second starting once every 80 seconds.
		25 hp to 75 hp	50 hp to 150 hp	150% torque on first point 10-second starting once every 80 seconds.
Starting and Speed Regulating Motors Shunt Wound only	Field only	Up to 25 hp	Up to 50 hp	100% torque on first point 5-second starting once every 80 seconds. Speed control any speed range desired up to 4:1.
		25 hp to 75 hp	50 hp to 150 hp	150% torque on first point 10-second starting once every 80 seconds. Speed control any speed range desired up to 4:1.
Starting and Speed Regulating Motors Shunt or Compound Wound	Armature only	Up to 40 hp	Up to 75 hp	Varying torque—50% speed reduction of motor at not less than 35% of full load torque. Constant torque—50% speed reduction of motor at not less than 80% of full load torque.
Starting and Speed Regulating Motors Shunt Wound only	Armature and Field	Up to 10 hp	Up to 20 hp	Varying torque—50% speed reduction of motor at not less than 35% of full load torque. Speed increase range up to 3:1. Constant torque—50% speed reduction of motor at not less than 80% of full load torque. Speed increase 25%.



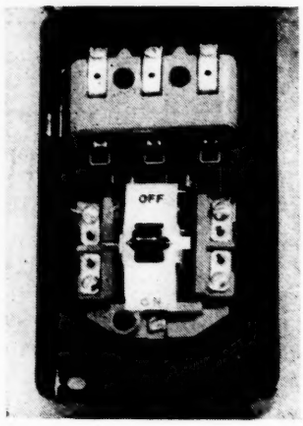


Fig. 3. (Left) Typical type C, 575-volt, a-c safety switch. Fig. 4. (Right) Manual starting which incorporates overload protection. Maximum horsepower ratings—5 at 220-volt, 7.5 at 440-600-volt polyphase.

These compact the unit to small size, and change operation from the movements of a hand to that of a finger. Note the arrangement and ease of wiring the starter shown in Fig. 4.

The most popular starter of all is the magnetic across-the-line type which gives thermal overload and under-voltage protection. Actuated remotely, the normal push button may be replaced by any number of devices to make up an automatic system. Any of the pilot control devices illustrated in Fig. 5 require only two wires between it and the starter. With such an arrangement of pilot wiring, a severe drop in line voltage will cause the starter to drop out and stop the motor. Resumption of normal voltage will start the motor automatically. When applied to a fan or blower, sump pump, circulating pump, vacuum pump or similar apparatus where unexpected starts are not liable to injure personnel or ruin product in process, this low-voltage release scheme is favored.

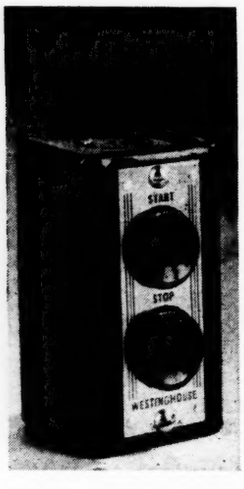
To control a motor on a machine where the starting must always be initiated by an operator in person, use a 3-wire control circuit known as low-voltage protection. The fundamental pilot control scheme differences are apparent on inspection of Fig. 6. Note the use of the interlock held closed while the starter contacts are closed on the 3-wire pilot control.

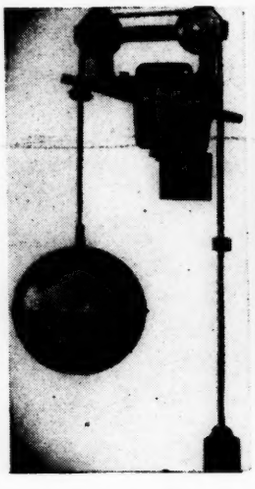
The use of a multi-speed squirrel cage motor is quite popular on varied condition ventilating systems. A motor of squirrel cage rotor construction can be had in two, three or four speeds. Motors of two speeds are usually single winding primary. By using suitable control to regroup poles, a low speed is obtained one-half that of the high speed. For example a 1760 rpm motor would reconnect to 890 rpm. The control actually regroups the stator coil windings to form a different number of poles in the polyphase field. A manually operated drum for pole changing, a suitable magnetic across-the-line starter for start and stopping, with the two suitably interlocked can be used. More popular is a full magnetic starter actuated by a push button marked "Fast"—"Slow"—"Stop". Sequencing and timing relays can be incorporated to insure always starting on slow speed and running before going to high speed.

Three and four speed motors are built with double windings in the stator. Each winding can be regrouped, thereby giving various speed combinations. For example, 1,800-, 1,200-, 900-, and 600-rpm synchronous speeds are possible. One winding is grouped 4-8 pole (1,800-900 rpm) and the other 6-12 pole (1,200-600 rpm). Control is usually of the magnetic full automatic type actuated from a 5-button push button station, or similar device. Each speed step should be timed and sequenced to insure against carless manipulation. A simplified schematic of starting a two speed single winding squirrel cage motor is shown by Fig. 8.

Practically all squirrel cage motors are suitable for line starting as far as mechanical construction is concerned. Inherently, the motor will draw five to six times its full load current and kva on inrush of starting. Many power companies have restrictions as to permissable maximum increment of draw from the line during starting. To meet limitations a reduced voltage type of starter may be required.

A manual or magnetically operated auto-transformer type of reduced voltage starter is a popular device quite simple in its operations. A limited capacity transformer is used to apply a voltage lower than that of the line to the primary of the motor. After starting, the motor is transferred to the line. The standard





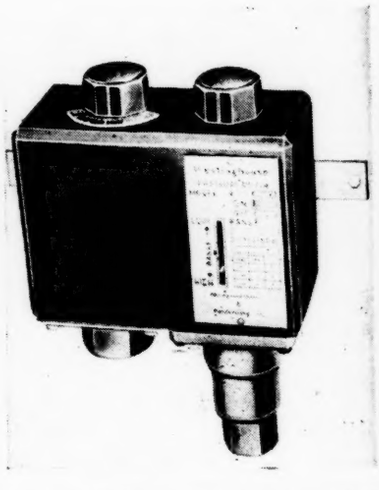
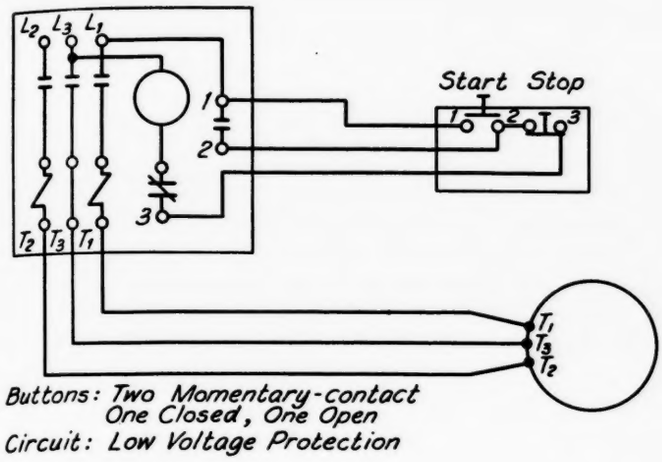


Fig. 5. Pilot devices for an across-the-line starter. Left to right, 2-button station, direct-acting limit switch, float switch, master switch, pressure and vacuum switch.



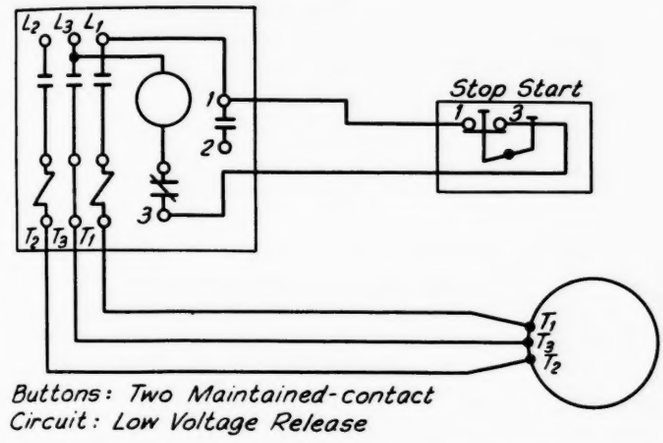


Fig. 6. Schematic of across-the-line starters incorporating two or three-wire pilot device.

Power line connection terminals L1, L2, L3 are usually located near the top of starters while lugs for connections to corresponding tagged motor leads T1, T2, T3 are found near the bottom. Terminals for pilot device connections are numerals without prefix. Printed instructions and diagrams are permanently fastened inside the starter cover.

auto-transformer for medium sized motors is supplied with taps offering a selection of either 85% or 65% line voltage. The starting current, kva and starting torque varies as the square of the voltage at the motor terminals. For example: A certain motor has a 600% inrush and 150% starting torque on full voltage. With an 80% tap the inrush would be $(80\%)^2 \times 600\% = 384\%$ and the starting torque would be $(80\%)^2 \times 150\% = 96\%$. In addition, the magnetizing current of the transformer would add approximately 25% to the motor inrush, making the total line input approximately = 409% of full load kva. The change from reduced voltage to line voltage on a standard auto-transformer type starter usually introduces an open transition period where a secondary "bump" is given the power line.

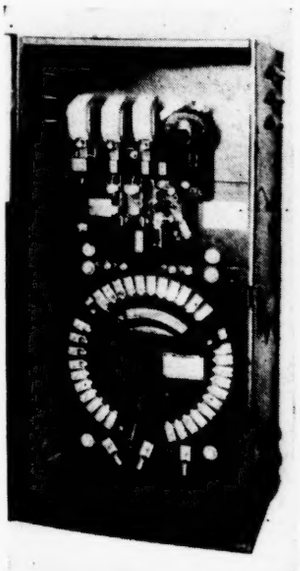


Fig. 7. Combined primary and manually operated secondary control for a wound rotor motor.

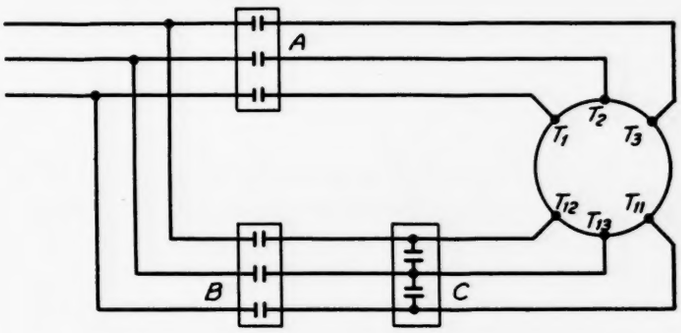


Fig. 8. Schematic of fundamental control used with a two-speed single winding squirrel cage motor.

Slow speed—B closed. High speed—A and C closed. High speed is exactly double low speed. For any other combination, two separate windings must be used and contactor C omitted.

To eliminate open transition and still further simplify the apparatus, resistance or a reactor may be used to reduce voltage impressed on a motor during starting. With this method of starting the kva inrush varies directly as the voltage at the motor terminals. Part of the inrush is absorbed by the resistance and part is taken by the motor. For example: A motor has a 600% inrush and 150% starting torque at full voltage. If the voltage across the motor terminals is 80% rated value, the inrush will be $80\% \times 600\% = 480\%$ and the starting torque will be $(80\%)^2 \times 150\% = 96\%$. The schematic for this type of reduced voltage starting is shown by Fig. 9.

A wound-rotor (slip-ring) motor is applied to a drive where high starting torque with low inrush is necessary or adjustable variable speed is required or a combination of both is advantageous. The stator or primary winding is similar to that of a squirrel cage motor, therefore the same type of across-the-line starter is used for its connection to the line. In addition, since the winding on the rotor can be reached through slip rings, external resistance is added to the secondary circuit to give the desired characteristics. For applications requiring motors up to 25 hp, (adjustable variable speed where manual operation is acceptable) a separately enclosed secondary rheostat can be used. Primary and secondary control should be so interlocked as to provide complete control from the rheostat handle. Various combinations of primary and secondary control in a unit cabinet are standard. A typical arrangement is shown by Fig. 7. For control above 25 hp the manual secondary incorporates a drum and separate mounted resistors. Here again, the interlocking should be such that the first point on the drum actuates the primary and successive notching cuts out resistance to raise the motor speed. Such an arrangement will insure always starting with full resistance in the secondary circuit. Manually operated drums are available for motors up to 1,000 hp or more.

A fan, blower or centrifugal pump may be driven by a wound rotor motor at less than full load speed. The secondary control is designed to give 50% speed reduction basis; the torque is approximately 35% of full load torque at half speed. On applications such as

Table 2 – Application Guide in Determining Current Inrush and Torques of Polyphase A-C Motors with Various Types of Starters and Control

Type Motor	Starting Torque	Starting Current	How Started	Starting Current % Full Load	Starting Torque 1750 rpm Motor	Starting Torque 1150 rpm Motor
Class A	Normal	Normal	Across-the-Line	600 - 700	1.5	1.35
			Resistance	480 - 560*	.96	.87
			Auto-Transformer	385 - 450*	.96	.87
Class B	Normal	Low	Across-the-Line	500 - 600	1.5	1.35
			Resistance	400 - 480*	.96	.87
			Auto-Transformer	320 - 385*	.96	.87
Class C	High	Low	Across-the-Line	500 - 600	2 to 2.5	
			Resistance	400 - 480*	1.28 to 1.6	
			Auto-Transformer	320 - 385*	1.28 to 1.6	
Wound Rotor	Heavy	Low	Secondary Controller	100% Current for 100% Torque	.....	
					Starting Torque	Pull-In Torque
Synchronous Low Speed	Low	.....	Across-the-Line	275	40%	40%
Synchronous High Speed	Low	.....	Across-the-Line	450 - 550	60%	110%
			Auto-Transformer	285 - 350*	38%	110%

*Using 80% taps.

centrifugal compressors requiring only 25% speed reduction for 50% capacity, where loads can be closely predicted for definite speed points, the resistance required can be accurately calculated. Speed will be consistant at each repeat point of operation from day-to-day. Adjustable variable speed control must be carefully applied in that the motor is considered "wild" at low speed. A slight change in load, after the speed has been adjusted, will cause a wide speed fluctuation.

Full magnetic control of the "price form" type replaces rheostats or drums with contactors and is applied for starting duty only. For applications requiring speed adjustment, a careful analysis of the load is required and definite speed points selected. Large motor secondaries may be regulated through motor operated drums or liquid rheostats.

Synchronous motors start as squirrel-cage motors, develop starting torques depending on the design of the damper "squirrel-cage" winding, and come up to approximately 95% synchronous speed. The application of excitation to the motor field poles bring about a sudden increase in speed to that of synchronism and produces a torque referred to as pull-in. Motors of 450 rpm and below are usually direct connected to the load and applied where low starting and pull-in torques are ample. Such a motor will require approximately 275% inrush current and is started across the line. High-speed synchronous motors, 514 rpm and above, inherently develop starting and pull-in torque above 100% but require 450-550% inrush. Control may be applied much the same as though a squirrel-cage motor were being used on the drive with the addition of apparatus to apply the field circuit. Field excitation is usually applied automatically through the use of a suitable relay. When the motor reaches about 90% speed, the field relay initiates a short-time delay before applying excitation, permitting the motor to accelerate to its maximum possible sub-synchronous speed. From this point, it can be synchronized with a minimum of line disturbance.

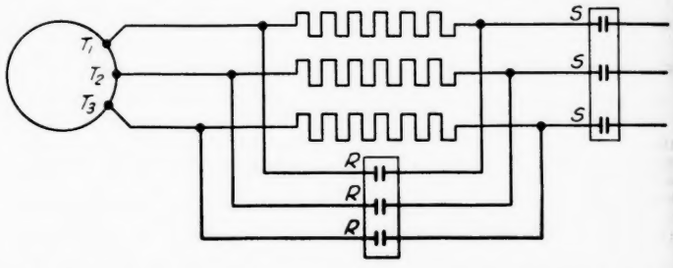


Fig. 9. Schematic of a series resistor or reactor reduced voltage starter.

Sequence, close S, close R. Resistance may be replaced by reactance connected in the same manner. As many steps as may be desired will be obtained by adding contactors to cut out part of the resistance.

During the time-delay interval, the field relay is automatically recalibrated to measure the angular position of the rotor with relation to the stator, so that excitation is applied only when these are in a favorable relationship for synchronization. This is accomplished in minimum time consistent with maximum speed, and at a favorable rotor position for the least line disturbance.

When not connected to the d-c excitation source, the field circuit should be shorted through a resistor to limit the transformer action in the field windings and prevent the building up of high potential dangerous to operators and apparatus.

Table 2 may be used as a guide in determining current inrush and torques of a-c motors with various types of starters and control.

COIL SELECTION FOR AIR CONDITIONING UNITS

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HEATING AND VENTILATING'S *Reference Section*

Coil Selection for Air Conditioning Units

J. E. YORK

Building Service Engineer, Stone & Webster Engineering Corp., Boston, Mass.

A presentation of the various steps required to determine the total cooling load, and the procedure necessary in selecting the coil surface to serve such a load.

AN air conditioning unit is a single piece of equipment designed and constructed to deliver a definite quantity of clean air at predetermined temperatures and percentages of relative humidity during the various seasons of the year.

Physically it generally consists of a casing of sheet metal in which are installed a filter, cooling and dehumidifying surface, heating surface, a humidifier, face and by-pass dampers, and one or more fans mounted on a common shaft and driven by a motor mounted on the outside of the casing. The casing is usually insulated and a drip pan is provided below the cooling surface to catch moisture from the air which is condensed on the cooling surface.

Air conditioning units are specially adaptable for use in a single room or a group of two or three small rooms which are to be maintained at the same conditions, or in places where the installation of central cooling equipment with extensive duct work is not feasible.

Types of Air Conditioning Units

Air conditioning units may be either of the following types:

Vertical floor mounted, Fig. 1, or horizontal suspended units, Fig. 2, with one or more outlets for connections through duct work to supply grilles in the spaces to be air conditioned. This type of unit is generally used where utility rather than appearance is of first importance, but in some cases it is possible to enclose the unit in closet space, or a small room where its appearance is not important, and to conceal the duct work.

Cabinet type units, Fig. 3, for installation without duct work in the space to be air conditioned.

Air conditioning units of each of these types may be equipped with cooling surface served by a suitable cooling medium from a source outside the area to be conditioned, or the units may be of the self-contained type, Fig. 4, with condensing equipment installed in the same cabinet as the cooling surface.

If the latter type of equipment is used, it will be necessary to provide cooling water supply and return connections or supply and exhaust air ducts to and from points outside the space to be air conditioned. Otherwise, the heat absorbed by the cooling surface, plus the heat input from the driving motor, would be delivered to the conditioned space with the result that the room would be warmed instead of cooled.

With the exception of the insulated casing, the drip pan and the cooling surface, air conditioning units are essentially of the same general construction as unit ventilators. There are, however, several types of cooling surface and each manufacturer has his own method of computing the cooling and dehumidifying capacities of these units.

Steps in Selection of an Air Conditioning Unit

After the temperature and relative humidity to be maintained inside an air conditioned space have been decided upon, and the outside design temperatures at which these conditions are to be maintained have been selected, the following steps are necessary for the proper selection of the air conditioning unit:

(1) Calculate the sensible, latent and total heat gains for the space to be air conditioned.

(2) Determine the sensible total heat ratio.

(3) Select the dry bulb temperature of the air to be supplied.

(4) Compute the quantity of air to be supplied to the room.

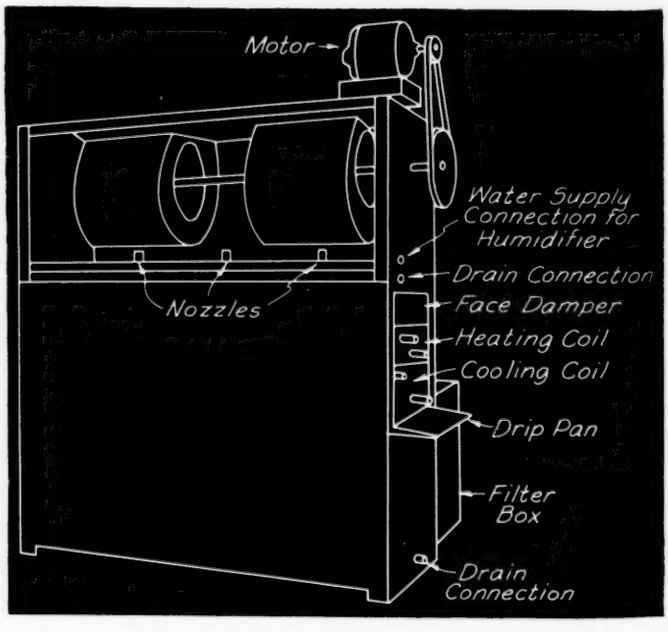


Fig. 1. Vertical floor mounted type of air conditioning unit

(5) Ascertain the wet bulb temperature of this air.

(6) Decide on the quantity of fresh air to be supplied to the room.

(7) Determine the condition of the mixture of recirculated and fresh air entering the air conditioning unit.

(8) After the condition of the air to be supplied to the room has been determined, a check must be made to find out whether it is possible to cool the air entering the unit to the required condition, or whether it will be necessary to subcool this air to reduce its moisture content and then reheat it.

(9) Compute the total cooling load.

All of the above steps will apply regardless of the cooling medium to be used or the make of the unit.

It next will be necessary to decide whether to use direct expansion type surface, chilled water, or brine type cooling surface.

After the type of surface has been selected, the following basic factors must be determined:

For Direct Expansion Units

(10) Refrigerant to be used.
(11) Surface temperature of the coil.
*(12) Suction temperature of the refrigerant.
*(13) Face area of coils and arrangement of tubing.
*(14) Number of rows of tubing.
*(15) The air friction through the coil.

For Chilled Water or Brine Type Units

(16) Temperature of inlet water or brine.
(17) Permissible temperature rise.
(18) Quantity of water to be circulated.
*(19) Face area of coils and arrangement of tubing.
*(20) Number of rows of tubes.
*(21) Water friction through tubes.
*(22) Air friction through cooling unit.

Note: Items marked (*) can only be determined by reference to data furnished by the manufacturers of cooling surface and by following the procedure outlined for use with these data. It should be understood that such data and procedure apply only to the particular make and type of cooling surface for which they were prepared and cannot be used for other makes or types.

In order to illustrate the procedure to be followed, assume that a room is to be maintained at 80F D.B. and 50% R.H. with outside air temperature at 95F D.B. and 76F W.B. The following paragraph numbers correspond to those of the section "Steps in Selection of an Air Conditioning Unit," page 66.

(1) Assume the sensible, latent and total heat gains have been computed as 270,000 Btu per hr, 30,000 Btu per hr and 300,000 Btu per hr respectively.

(2) The sensible total heat gain ratio will be 270,000/300,000 or 90%.

(3) The dry bulb temperature of the air to be supplied to the room should next be determined as follows:

On the psychrometric chart, Fig. 5, locate point *R*

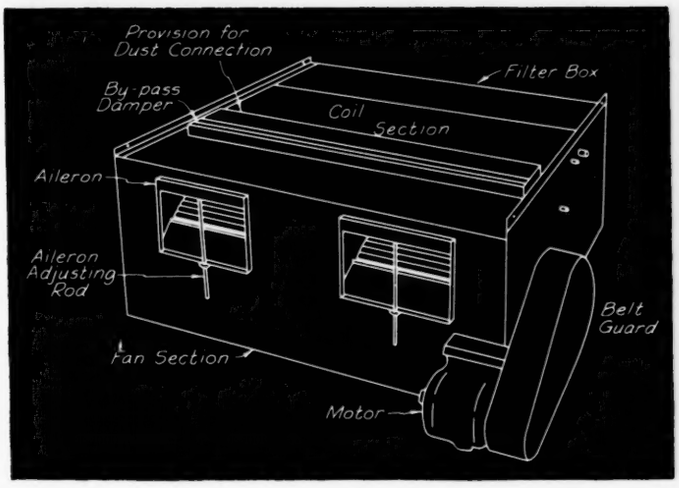


Fig. 2. Horizontal suspended type of unit

at the desired room conditions of 80F D.B. and 50% R.H. (67F W.B.) and from this point draw a line at an angle corresponding to the sensible total heat ratio. This may be determined by means of a special rule designed for use with the chart or by the use of a chart on which graduations are provided for the purpose. In this example, the first is used.

This line should be extended to intersect the saturation line. Air supplied in suitable quantities at any condition along this line will give the desired conditions in the room. Air supplied at a condition not on this line will not produce the desired conditions in the room.

In general, it is advisable to limit the temperature differential between the room condition and entering air to not more than 20F, and it is desirable if it can be accomplished without excessive drafts to reduce this differential to 18F or even 16F.

Let us assume that a differential of 18F is to be used and the dry bulb temperature of the entering air will be 80—18 or 62F.

(4) The quantity of air to be circulated may now be found from the formula:

$$cfm = H_s \div (1.08 \times T_d)$$

where H_s is the sensible heat to be removed

T_d is the temperature differential

1.08 is the heat in Btu per hour required to raise the temperature of air 1F when supplied at the rate of 1 cfm.

$$cfm = 270{,}000 \div (1.08 \times 18) = 14{,}000 \text{ cfm}$$

approximately.

(5) The wet bulb temperature of the entering air may now be found from the chart at *B* the point of intersection of the dry bulb temperature and the sensible heat ratio line which in this case is 60F W.B.

(6) The quantity of fresh air to be supplied to the room is commonly based on the number of occupants of the room and the cubic feet of fresh air to be allowed per person. Assuming that there are 100 persons in the room and 20 cfm per person to be supplied, the total will be 2,000 cfm.

(7) The condition of the air entering the air conditioning unit must now be determined. This air will be a mixture of 12,000 cfm of room air at 80F D.B. and 67F W.B. and 2,000 cfm of outside air at 95F D.B. and 76F W.B.

On the psychrometric chart, Fig. 5, draw a line between these conditions shown at points *R* and *O* respectively, and at a point 2,000/14,000 or 1/7 of the linear distance *R O* from the point *R* locate point *A* corresponding to the entering air temperature of 82F D.B. and 68.5F W.B.

(8) In Fig. 5 it will be observed that the sensible total heat ratio line is almost horizontal, and crosses the saturation curve at a moderate temperature. This is because the latent heat load is relatively small.

When the latent heat load is relatively large the sensible total heat ratio line will be more nearly vertical and may only intersect the saturation curve at a very low temperature or not at all. In the first case it will be necessary to maintain excessively low surface temperatures for the coil with consequent low suction pressure of the refrigerant, greater cooling load and larger condensing equipment. It will generally also result in lower temperature of the air leaving the air conditioning unit which may prove very objectionable to occupants of the room.

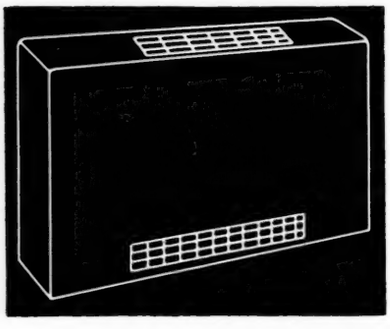


Fig. 3. Cabinet type installation without ducts

If the sensible heat ratio line cannot be extended to intersect the saturation line, the air entering the unit cannot, by cooling only, be delivered at a suitable condition to maintain the desired dry and wet bulb temperatures in the room.

In each of the above cases the air may be subcooled to reduce its moisture content, and then reheated to bring the dry bulb temperature to the desired level.

The following example will serve to illustrate the second condition:

If, in the previous example, the internal latent heat gain were 230,000 Btu per hr, with the same sensible heat gain of 270,000 Btu per hr, the total heat gain would be 500,000 Btu per hr and the sensible total heat ratio would be 54%.

In this case the sensible total heat ratio line would be as shown on the psychrometric chart in Fig. 6, and would be too steep to intersect the saturation curve.

A vertical line representing the desired dry bulb temperature for air entering the room should be drawn to intersect the sensible total heat ratio line. This intersection occurs at a point *B* corresponding to 62F D.B. and 55F W.B. and a dew-point temperature of 50F. A horizontal line or constant total humidity line should be drawn through the point *B* to the saturation line. From a point *S* about 3 degrees lower than the dry bulb temperature corresponding to the intersection of the constant humidity line with the saturation curve, a line should be run to point *A* (the entering air temperature of 82F) as previously determined.

The point *D* at the intersection of the line *SA* and the constant total humidity line through *B* will indicate the condition at which the air should leave the cooling coil.

This air should then be reheated without the addition of any moisture (along the constant humidity line) to the point *B*.

(9) If, after checking as outlined under (8) it is found that the desired condition of the air can be obtained by cooling only, the total cooling load may be determined as follows:

$$H_c = \frac{\text{cfm air} \times 60 \times (H_a - H_b)}{\text{cfm per lb air}}$$

where H_c = total cooling load in Btu per hr

H_a = total heat of air at condition *A* where it enters the coil (at 68.5F W.B.)

H_b = total heat of air at condition *B* where it leaves the coil (at 60F W.B.)

$$H_c = \frac{14{,}000 \times 60 \times (32.75 - 26.40)}{13.5}$$

$$= 400{,}000 \text{ Btu per hr approximately.}$$

In the second example the formula would be changed to use the total heat of the air at condition *D* in place of condition *B* as follows:

$$H_c = \frac{14{,}000 \times 60 \times (32.75 - 21.11)}{13.5}$$

$$= 730{,}000 \text{ Btu per hr approximately.}$$

The approximate reheating load would be:

$$H_r = \frac{14{,}000 \times 60 \times (23.18 - 21.11)}{13.5}$$

$$= 130{,}000 \text{ Btu per hr.}$$

Selection of the Cooling Medium

The cooling medium for use with coil surface may be:

(1) A suitable refrigerant directly expanded in the coil.
(2) Chilled water.
(3) Chilled brine.

The use of direct expansion refrigerant in air conditioning systems is generally restricted to nontoxic, nonirritant, nonexplosive and nonflammable gases. Of these Freon (F-12) is most commonly used.

When water of suitable temperatures is not available from wells or other sources at low cost, the use of direct expansion type surface will generally be most economical in first cost and in cost of operation as it eliminates the necessity of installing water or brine coolers, pumps and relatively large insulated water mains, as well as the cost of pumping.

Expansion valves have been developed to a point where they are relatively simple in construction, reliable in operation and low in cost.

Where long mains with many joints are necessary between condensing equipment and air conditioning units, the possibilities of leakage with high replacement costs for refrigerant may make it desirable to provide water cooling equipment close to the condensing units and to circulate chilled water to the coils.

Where low temperatures and humidities are to be maintained, it may be necessary to carry surface temperatures in the coils which might entail danger of freezing and damage to the coil surface if water were used. In such cases brine at suitable density to safeguard against freezing may be used.

Calcium brines do not have any corrosive effect on steel pipe, and strong solutions of salt brine may be used without any appreciable effect.

Selection of Direct Expansion Type Surface

Assuming that direct expansion type surface using Freon (F-12) is to be used in the air conditioning unit to be installed for the first example, the method of determining surface temperature of the coils, the suction temperature of the refrigerant, the face area and arrangement of tubing, the number of rows of tubing and the air friction through the coil will be illustrated for two different makes of coil surface, each supplied by manufacturers of national reputation for high grade equipment.

The procedure outlined by the first manufacturer takes as a starting point the well known fact that when air passes over a cooling surface the temperature of which is below the initial dew-point of the air, the absolute humidity is reduced in direct proportion to the temperature reduction.

From this premise a temperature-humidity reduction constant has been developed. This constant may be defined as the ratio of the difference between the dry bulb temperature of the entering and leaving air to the difference between the dry bulb temperature of the entering air and the temperature of the cooling surface.

This may be expressed mathematically as follows:

$$C_a = \frac{t_e - t_l}{t_e - t_s}$$

where t_e is the entering air dry bulb temperature
t_l is the leaving air dry bulb temperature
t_s is the surface temperature

The same value of the constant will apply to the reduction in the absolute humidity, and may be expressed as follows:

$$C_a = \frac{W_e - W_l}{W_e - W_s}$$

where W_e = entering air grains of moisture per pound of air
W_l = leaving air grains of moisture per pound of air

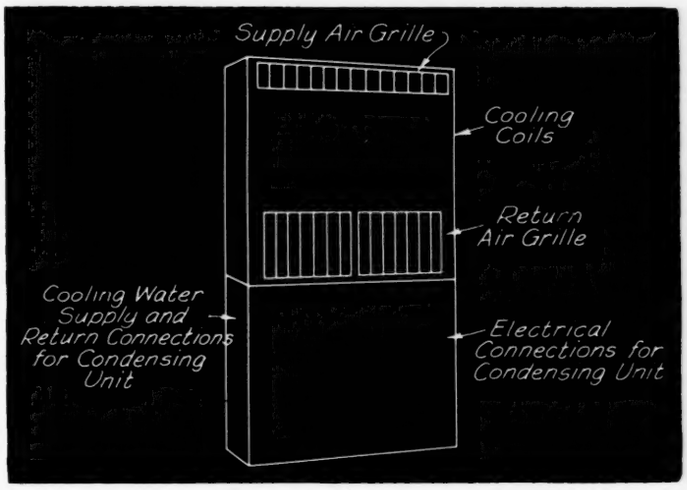

Supply Air Grille
Cooling Coils
Return Air Grille
Cooling Water Supply and Return Connections for Condensing Unit
Electrical Connections for Condensing Unit

Fig. 4. Self-contained air conditioning unit

W_s = grains of moisture per pound of saturated air at coil surface temperature

Values of C_a vary with the face velocity and the number of rows deep of the coil surface, as shown in the following tables:

Face velocity 500 fpm		Face velocity 300 fpm	
1-row coil	$C_a = 0.290$	1-row coil	$C_a = 0.350$
6-row coil	$C_a = 0.870$	6-row coil	$C_a = 0.920$

A sensible cooling constant K_a has also been developed which simplifies the heat transfer computations by its use with the difference between the entering air dry bulb temperature and the coil surface temperature, thus eliminating the more complicated process of determining the log mean temperature difference between the air and the coil surface.

This may be expressed mathematically, as follows:

$$H_s = K_a \times A_f \times (t_e - t_s)$$

where H_s = sensible capacity of the coil surface in Btu per hr
K_a = sensible cooling constant
A_f = face area of coil in square feet
t_e = entering air dry bulb temperature
t_s = surface temperature of the coil

The value of K_a also varies with the face velocity and the number of rows of coils, as shown in the following table:

Face velocity 500 fpm		Face velocity 300 fpm	
1-row coil	$K_a = 155$	1-row coil	$K_a = 110$
6-row coil	$K_a = 460$	6-row coil	$K_a = 295$

A third constant D_r indicates the necessary differential between the cooling surface temperature and the refrigerant temperature to absorb a given amount of heat.

This differential varies with the total amount of heat per square foot of face area which the coil surface must absorb and the number of rows of coil.

The following values of D_r serve to show this variation:

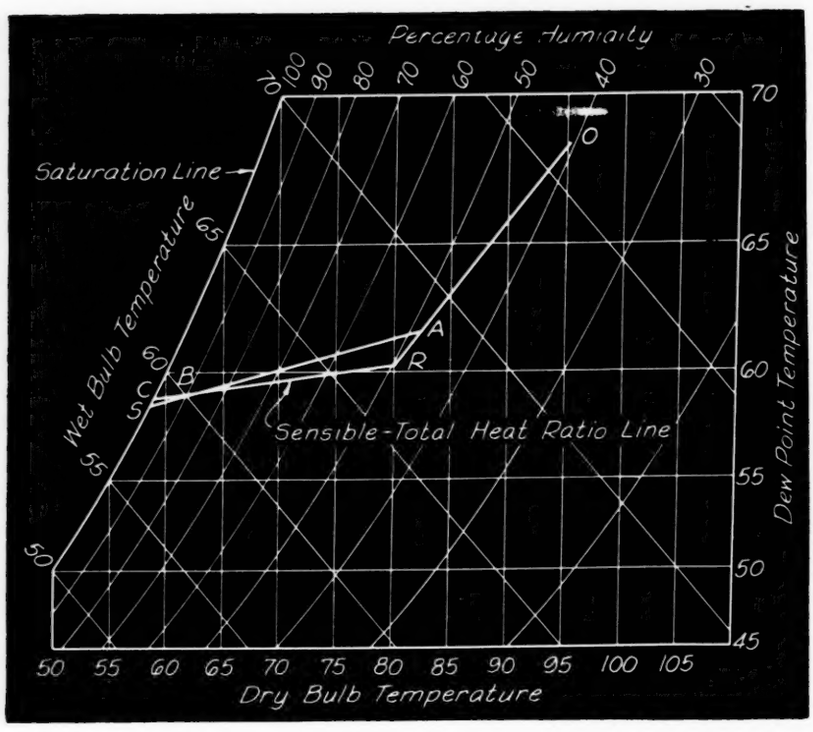


Fig. 5. Design conditions plotted on a Trane psychrometric chart

Load 20,000 Btu per sq ft face area		Load 10,000 Btu per sq ft face area	
6-row coil	$D_r = 11.6$	6-row coil	$D_r = 8.4$
3-row coil	$D_r = 18.4$	3-row coil	$D_r = 11.8$

To determine the total heat load on a square foot of face area, it is necessary to determine the volume of air passing through 1 sq ft of face area of the coil and to determine the sensible and latent heat load for this air.

The sensible heat load may be determined from the following formulas:

$$H_s = \text{cfm} \times 1.06 \times (t_e - t_l)$$

and the latent heat as follows:

$$H_l = \text{cfm} \times 0.66 \times (W_e - W_l)$$

where cfm = total air flow through 1 sq ft of face area in cubic feet per minute

t_e = entering air dry bulb temperature

t_l = leaving air dry bulb temperature

W_e = entering air absolute humidity in grains per pound of air

W_l = leaving air absolute humidity in grains per pound of air

The sum of H_s and H_l will give the total heat load.

The direct expansion type cooling surface for the first example may now be selected by the use of these three constants and accompanying tables.

In this example the basic conditions were previously determined as follows:

Outdoor dry bulb temperature	t_o = 95F D.B.
Outdoor absolute humidity	W_o = 105 gr. (95F D.B. and 76F W.B.)
Indoor dry bulb temperature	t_i = 80F D.B.
Indoor absolute humidity	W_i = 77 gr. (80F D.B. and 50% R.H.)
Total air to be circulated	= 14,000 cfm
Fresh air to be supplied	= 2,000 cfm
R	= 1/7

The temperature of the air entering the coils may be found from the following formula:

$$t_e = t_l + R\,(t_o - t_l)$$

where t_e is the dry bulb temperature of air entering the cooling coil and other values are as noted above. Therefore $t_e = 80 + 1/7\,(95 - 80) = 82.14$F D.B.

Similarly the moisture content W_e of the air entering the coils may be found from the following formula:

$$W_e = W_i + R\,(W_o - W_l)$$

therefore $W_e = 77 + 1/7\,(105 - 77) = 81$ gr.

The condition of the air leaving the surface after removal of the required amounts of sensible and latent heat may now be computed as follows:

$$t_l = t_e - \frac{H_s}{\text{cfm} \times 1.06}$$

where t_l is the dry bulb temperature of the air leaving the unit

H_s is the sensible heat to be removed from this air

H_s = room sensible heat gain + cfm fresh air $(t_o - t_l) \times 1.06$

$H_s = 270{,}000 + 2{,}000\,(95 - 80) \times 1.06 = 301{,}800$ (302,000 Btu approx.)

$$t_l = 82.14 - \frac{302{,}000}{14{,}000 \times 1.06} = 61.84\text{F D.B. or } 62 \text{ approx.}$$

The absolute humidity of the air leaving the unit may now be found from the following formula:

$$W_l = W_e - \frac{H_l}{\text{cfm} \times 0.66}$$

where W_l is the absolute humidity of the air leaving the unit

H_l is the latent heat to be removed from the air

H_l = room latent heat gain + cfm air $(W_o - W_l) \times 0.66$

$H_l = 30{,}000 + 2{,}000\,(105 - 77) \times 0.66 = 67{,}000$ Btu

$$W_l = 81 - \frac{67{,}000}{14{,}000 \times 0.66} = 73.8 \text{ gr.}$$

Summarizing these results we find:

	Air entering unit	Air leaving unit
Dry bulb temperature	82.1 F	62.0 F
Absolute humidity	81 gr	73.8 gr
Wet bulb temperature	67.5 F	60 F
Total heat	31.9 Btu	26.4 Btu

The required surface temperature of the coil may now be determined graphically by drawing a line through the points on the psychrometric chart corresponding to the entering and leaving air conditions of the coil. This line AB on the psychrometric chart in Fig. 5, when continued to the point S where it intersects the saturation curve, establishes the surface temperature of the coil at 58.5F.

The value of the constant C_a may now be determined as follows:

$$C_a = \frac{82.1 - 62.0}{82.1 - 58.5} = 0.85$$

Consulting curves furnished by the manufacturer we find that for the above value of C_a either a 4-row coil with a face velocity of 200 fpm or a 6-row coil with a face velocity of 500 fpm may be selected.

A face velocity of 500 fpm is preferable as it will improve the proportion of the unit and will greatly decrease the space requirements.

Face Area

The face area may now be determined by dividing the total air flow in cfm (14,000) by the selected face velocity (500) giving a face area of 28 sq ft.

There may be a choice of several 6-row coils of varying lengths and number of tubes across the face of the coil. In general, longer tubes with a lesser number of tubes across the face of the coil are most economical in first cost, but the adaptability of the coil must be considered for use in the same housing in which heating coils, filters and fans are to be installed.

Coils with either 12 or 18 rows of tubes across the face are desirable because they permit division of the cooling surface into two or three sections each supplied by its own expansion valve and distributing chamber.

The sensible cooling capacity of the coil may now be determined from the formula previously given, as follows:

$H_s = K_a \times A_f \times (t_r - t_s)$

$H_s = 460 \times 28 \times (82.14 - 58.5) =$ 304,000 Btu per hr.

This checks closely with the previously computed value of H_s.

Refrigerant Temperature

The refrigerant temperature inside the tubes may next be determined as follows:

Divide the total heat load on the coil by the square feet of face area to give the load per square foot of the face area.

The total load $= H_s + H_l = 302{,}000 + 67{,}000 =$ 369,000 Btu per hr.

$369{,}000/28 = 13{,}000$ Btu per sq ft of face area.

The manufacturers' curves indicate that with this loading for a 6-row coil, the value of D_r should be 9.5F.

The temperature of the refrigerant should, therefore, be 58.5 — 9.5 or 49F.

Air friction through a 6-row coil at 500 fpm face velocity is found to be approximately 0.40 in. S.P.

The second manufacturer uses tables based on the following formulas:

Total heat in Btu per hr $= L \times$ cfm $\times (H_a - H_c)$

Total heat in Btu per hr $= M \times FA \times (t_c - t_t)$

where

cfm = cubic feet of air per minute at standard conditions

H_a = total heat of air at entering wet bulb condition

H_c = total heat of air at coil temperature

H_t = total heat in Btu per hour to be dissipated

t_c = wet bulb temperature corresponding to H_c

t_t = saturated suction temperature of the refrigerant at the coil

FA = face area of coil in square feet

L and M are factors as follows:

L and M Factors for 8 Fins per Inch

Rows deep	L	M
1	1.48	400
2	2.45	800
3	3.07	1,200
4	3.47	1,600
5	3.78	2,000
6	4.05	2,400

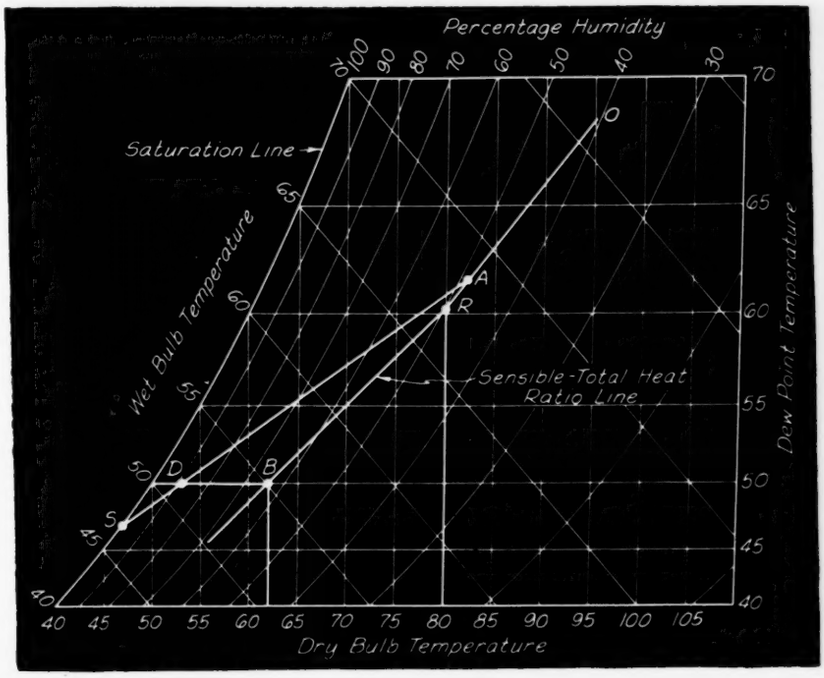


Fig. 6. Design problem conditions plotted on a Trane psychrometric chart

The following values have been previously determined:

cfm — 14,000 cfm
H_a — for entering air at 68.5F W.B. = 32.75 Btu
H_c — at 58.5F W.B. (S in Fig. 5) = 25.40 Btu
H_t — 400,000 Btu
t_c — 58.5F
t_t — to be determined
FA — to be determined
L and M to be determined

Using a modification of the first of these two formulas and solving for *L*, we find:

$$L = \frac{400{,}000}{14{,}000\ (32.75 - 25.40)} = 3.90$$

Coil Required

From the table of values of *L* we find that this would require a coil 6 rows deep and *M* would be 2,400. Assuming a face velocity of 500 fpm the required face area would be:

$$\frac{\text{Total cfm}}{\text{Face velocity}} = \frac{14{,}000}{500} = 28 \text{ sq ft}$$

Stock sizes of units require the use of 2 units 29 in. wide with tubes 6½ ft long having a total face area of 27 sq ft. Therefore with the following values, already determined,

M = 2,400; FA = 27 sq ft; T_c = 58.5F, the saturated suction temperature t_t of the refrigerant in the coil may be determined from the following modification of the second formula:

$$t_t = t_c - \frac{\text{Total heat removed, Btu per hr}}{M \times FA}$$

$$= 58.5 - \frac{400{,}000}{2{,}400 \times 27} = 52.3\text{F refrigerant suction temperature}$$

The air friction may next be determined, as follows:

$$\text{Actual face velocity} = \frac{\text{Total cfm}}{\text{Face area}} = \frac{14{,}000}{27} = 520 \text{ fpm}$$

From the manufacturers' tables the friction through a 6-row coil at 520 cfm air velocity is found to be 0.415 in. S.P.

Below are the results of these two independent methods of selection of similar type of coil surface:

Mfr.	Face Area of Coil, sq ft	No. Rows Deep	Suction Temperature, F	Air Friction In. S.P.
A	28	6	49.0	0.400
B	27	6	52.3	0.415

Chilled Water and Brine for Cooling Coils

If the use of direct expansion type surface is not considered desirable, and if the entering and leaving temperatures of the water or brine and the number of gallons per minute to be circulated are not predetermined by the necessity of tying in to an existing system, or by other limitations, consideration should be given to the following six factors:

Large quantities of water will:

(1) Require smaller differentials between entering and leaving water temperatures and air and water temperatures;

(2) require a greater amount of cooling surface in the air conditioning unit;

(3) require larger chilled water mains which are expensive to insulate;

(4) require larger pumping equipment; or,

(5) if sizes of mains are not increased, more friction and higher pressures on all of the piping and equipment;

(6) may in some cases permit the use of higher suction pressures and consequently smaller condensing equipment.

Smaller quantities of water will have the reverse effects.

Counterflow

Counterflow of air and water through coil surface should always be used in order to obtain the maximum capacity from the coil, and while it is possible by this method to bring the dry bulb temperature of the air leaving the unit down to a point about 3F higher than the entering water temperature, this usually requires an excessive amount of coil surface.

Based on the paragraph numbers under the sub-head "Direct Expansion Units" page 67, then

(16) The most economical differences between the leaving air dry bulb temperature and the entering water temperature t_1 is in the range from 6 to 8F.

(17) The temperature t_o of the water or brine leaving the coil should be 10F or more below the dry bulb temperature of the entering air. The difference between t_1 and t_o will give the permissible temperature rise.

(18) With the entering and leaving water or brine temperature known, the quantity of water to be circulated may be determined from the following formula:

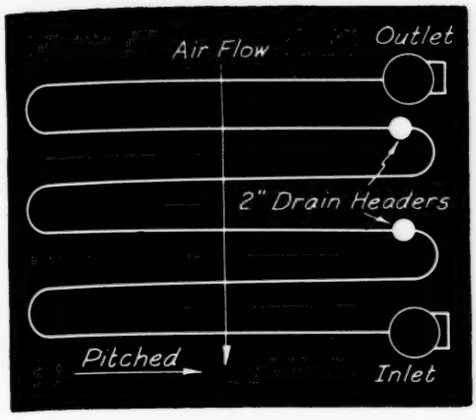
$$W = H_t/(t_o - t_1)$$

Where *W* is the weight of water in pounds per hour, and H_t is the total heat to be removed from the air.

Water Temperature Rise

With 62F D.B. temperature of leaving air, assume the temperature of the entering water is 55F, and with a temperature of 82F for the entering air, assume the temperature of the water leaving the coil is 67F. This gives a 12F rise for the water.

H_t was previously determined as 400,000 Btu per hr.



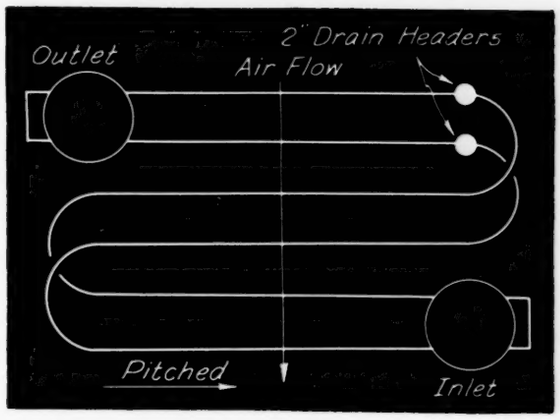


Fig. 7 (left). Plan of a single serpentine coil—6 rows. Fig. 8 (right). Plan of a double serpentine coil—6 rows.

The quantity of water to be circulated may now be computed as follows:

$$W = 400{,}000/(67 - 55) = 33{,}000 \text{ lb per hr, approx.}$$
$$33{,}000/(60 \times 8.3) = 66 \text{ gpm.}$$

From this point on the computations must be based on data furnished by the manufacturer whose equipment will be used.

In general it may be stated that water velocities through coils should be 3 fps or higher in order to prevent reduction of the heat transfer coefficient due to formation of a stagnant film of water on the inside surface of the coils.

The most economical face velocities of air through the cooling surface will generally be between 400 and 600 fpm. In case of heavy cooling loads it is usually advisable to reduce the face velocity to the lower limit of 400 fpm in order to keep the air friction through the coil to a minimum.

The heat transfer coefficient in Btu per hour per row per degree of log mean temperature difference per square foot of face area at 3 fps water velocity, and with air velocity of 500 fpm per sq ft of face area of coil, will be approximately 170.

Log Mean Temperature Difference

The method of determining the log mean temperature difference (LTD) may best be shown by the following example:

If in this case, as in the previous example, it is desired to have the air leave the coil surface at a temperature of 62F D.B., the cooling water should enter at about 7F below this temperature or 55F, and allowing a 15F differential between the dry bulb temperatures of the entering air and the temperature of the water leaving the coil, this latter temperature will be 67F. The LTD (Log mean temperature) may be determined as follows:

Dry bulb temperature entering air	82	Dry bulb temperature leaving air	62
Temperature water leaving	67	Temperature water entering	55
	15		7

LTD = 10.55 (determined by the following table)

D. B. temperature leaving air less temperature water entering	D. B. temperature entering air less temperature water leaving					
	9	10	12	14	16	18
	Log Mean Temp. Differences					
5	6.75	7.20	8.00	8.75	9.50	10.20
6	7.50	7.90	8.75	9.50	10.20	11.00
7	8.00	8.45	9.30	10.20	10.90	11.70
8	8.50	9.00	10.00	10.80	11.65	12.50
9	9.00	9.50	10.50	11.45	12.25	13.00

Selection of Coil for Water Cooling

Again using the previous example, a coil using chilled water for cooling the air through the desired range may be selected in accordance with the following procedure of a nationally known manufacturer of water and brine cooling surface.

The necessary data for the selection of the coil is as follows:

Total amount of air to be cooled, 14,000 cfm.

Entering air temperature, 82.14F D.B. and 68.5F W.B.

Leaving air temperature, 62F D.B. and 60F W.B.

Temperature of water entering unit, 55F.

Quantity of water available, 66 gpm.

The total load H_t to be absorbed by the coil under these conditions was previously found to be approximately 400,000 Btu per hr.

The water temperature rise T_r through the coil with 66 gpm available will be

$$\frac{H_t}{\text{gpm} \times 60 \times 8.3} = \frac{400{,}000}{66 \times 60 \times 8.3} = 12\text{F approx.}$$

With an air velocity of 500 fpm, the

$$\text{Face area} = \frac{14{,}000}{500} \text{ or } 28 \text{ sq ft.}$$

From the manufacturers' data sheets of standard size coils, two coils each 24 in. nominal face width and with 84-in. tubes, or two coils each 30 in. nominal face width and with 66-in. tubes may be selected. The selection may be governed by the adaptability of the physical dimensions of the coil surface to other parts of the unit.

The water velocity through the coils must next be

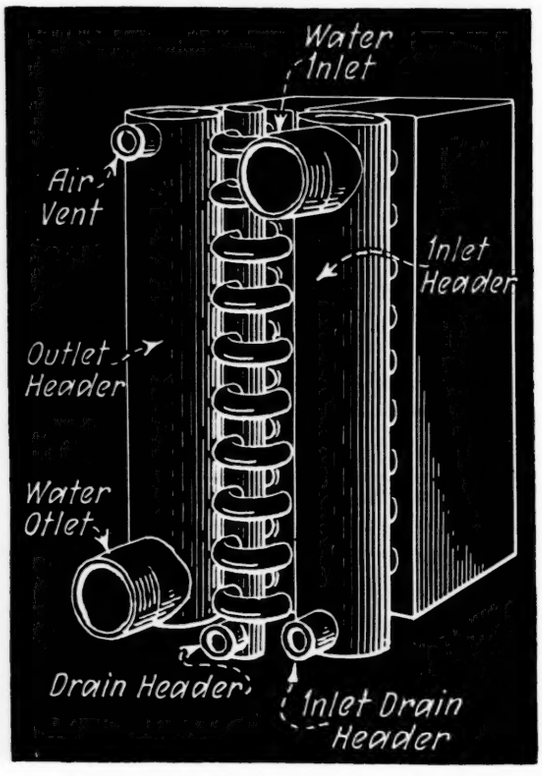


Fig. 9. Unit provided with drain headers between inlet and outlet headers

determined. With two sections, each section should receive 33 gpm.

From the manufacturers' curves, we find that the water velocity through a two-row unit with 30-in. face width would be approximately 1.75 fps.

With a single row unit with 30-in. face, the water velocity will be 3.5 fps which will give a better rate of heat transfer.

Moisture Factor

As there will be moisture condensed out of the air on to the coil surface which is at a temperature below the dew-point of the entering air, a factor for increase in heat transfer due to wetted fin surface F_w should next be determined, as follows:

Entering air dry bulb	82.14	Entering air dew-point	61.5
Entering water temp.	55.00	Entering water temp.	55.0
Difference	17.14	Difference	6.5

From the manufacturers' chart under these conditions, the heat transfer factor will be 1.16.

The Log MTD may now be determined as follows:

Dry bulb temperature entering air	82.14	Dry bulb temperature leaving air	62.0
Temperature of leaving water	67.00	Temperature of entering water	55.0
Difference	15.14	Difference	7.0

Log MTD from tables.....10.6 approximately

The heat transfer coefficient *HTC* with a water velocity through the coil of 3.5 fps and 500 fpm face velocity of air through the coils is found from the manufacturers' data to be 171.

Note: If the water velocity of 1.75 fps had been used this value would have been only 156.5 Btu per hour per row of tubes per degree of mean temperature difference per square foot of face area.

Number of Rows

The number of rows of tubes may now be found from the following formula:

$$\text{Rows of tubes} = \frac{\text{Total load in Btu per hour}}{\text{Face area} \times \log \text{MTD} \times \text{HTC} \times F_w}$$

$$= \frac{400{,}000}{28 \times 10.6 \times 171 \times 1.16}$$

Therefore use 7 rows.

Therefore, two tiers of coil surface, each consisting of one 4-row and one 3-row single row serpentine coil in series, and the two tiers operating in parallel, should be provided.

The air friction through the coil surface must now be determined from the tables and for 7 rows of coil at 500 fpm face velocity this will be 0.40 in.

The friction of water through the coils may now be determined. The total water travel through single row coils 7 rows deep, 66 in. long will be 7 by 66 12 or 38.5 ft. The water friction at water velocity of 3.5 fps is found from the manufacturers' chart to be 6.5 ft for each 10 ft, or a total of 25 ft.

Other well-known manufacturers of water type cooling surface furnish similar data and procedure to be followed in selection of the cooling surface which they manufacture. Careful study of such data is desirable and will prove instructive to the reader who will spend the time to analyze such information.

Construction of Cooling Coils

There are a number of well-known manufacturers of cooling surface designed for use with chilled water, brine or direct expansion refrigerant, and each of these can present reasonable claims for superiority of design or construction of their product in one or more details.

Regardless of make, for maximum efficiency, direct expansion type cooling surface must be designed to meet the following requirements:

(1) Even distribution of refrigerant through the coil in order that each portion of the coil may do its proper share of the work.

(2) Short path of travel for the refrigerant through the coil in order to reduce the pressure drop.

(3) Coils must be designed to insure maximum heat transfer between the inside surface of the tubes and the refrigerant as it vaporizes.

(4) The prime and secondary surface must be designed to provide maximum heat transfer between the air passing through the unit and the coil.

The first of these requirements is commonly met by use of one or more distributing chambers, each of

which is supplied by one expansion valve with the necessary refrigerant, and distributes this by means of properly sized branch tubing to the several portions of the cooling coil. In one widely used make of coil surface the even distribution of the refrigerant is accomplished by means of a header divided into two or more chambers fed through metering orifices and each serving one portion of the cooling surface.

Face or Row Control

Coils may be arranged either for face control or row control. Where face control is desired, these units can be obtained in 2 to 6 rows deep in the direction of air flow and in 12, 18 and 24 tubes across the face.

Each distributing header which is of the so-called centrifugal type delivers the expanded refrigerant to six tubes in the first row, and from there it is fed through the corresponding tubes in as many rows (2-6) as are required, and at the last row corresponding collector headers are provided for removal of the refrigerant after it has done its work.

This arrangement can be used to advantage where two or more condensing units are provided as it provides a positive method for dividing the load between the compressors.

It should be noted that with this arrangement, when the expansion valve for any circuit is closed or the refrigerant supply is shut off in any other manner, that portion of the air which passes through the circuit is not air conditioned.

When row control is desired a separate thermal expansion valve and distributing header is required for each row in depth for each unit with a corresponding outlet header for each row.

This arrangement provides individual control of each row of coil in depth without allowing any unconditioned air to pass through the coil.

The third requirement is met by selection of tubing of proper diameter to insure turbulence and velocities of vaporized refrigerant which will provide the maximum rate of heat transfer.

Maximum Heat Transfer

The fourth condition requires proper proportioning of the prime and secondary surface, permanent effective bonding of these two together to insure rapid heat transfer from prime to secondary surface, and design and construction of the secondary surface to insure most effective wiping action of the air in its passage over this surface.

Direct expansion type cooling surface is made in sections from 2 to 6 rows deep, and is commonly obtainable in tube length increments of 6 in. from 2 ft to 7 ft and in various face widths from 12 in. to 32 in.

Tubes vary from ½-in. to ⅞-in. diameters with thicknesses of from 0.028 in. for steel to 0.035 in. for copper and are constructed of various materials, including copper, Admiralty metal and steel to suit the requirements of the customer.

Provision for movement of the tubes due to contraction and expansion under changing temperatures is usually made by the use of return bends on the coils and the spacing of supports to permit restricted movement of the coils.

A 10:1 ratio of external to internal heating surface is provided in some makes of direct expansion coil surface for air conditioning units.

Where it is necessary to cool the air to near freezing temperatures, pipe coils without finned surface are sometimes used in order to reduce the frequency and length of time required for defrosting.

Face velocities of the air passing through the coil surface of 500 fpm are commonly used. Condensation begins to be carried off the coils into the air stream at about 450 fpm and with air velocities of 600 fpm this water may be carried in the duct work unless eliminator plates are used.

Where coils are installed in two or more units high, there is danger of water dripping from the higher to the lower unit, and splashing into the air stream unless troughs are provided for each bank to collect the moisture.

Water type cooling surface is available in various combinations from 2 to 8 rows deep.

Where only moderate quantities of water are available, a header may be provided on the first row of tubes to distribute the cold water evenly over the face of the unit. Corresponding tubes in successive rows are arranged in series. See Fig. 7.

Excessive Resistance

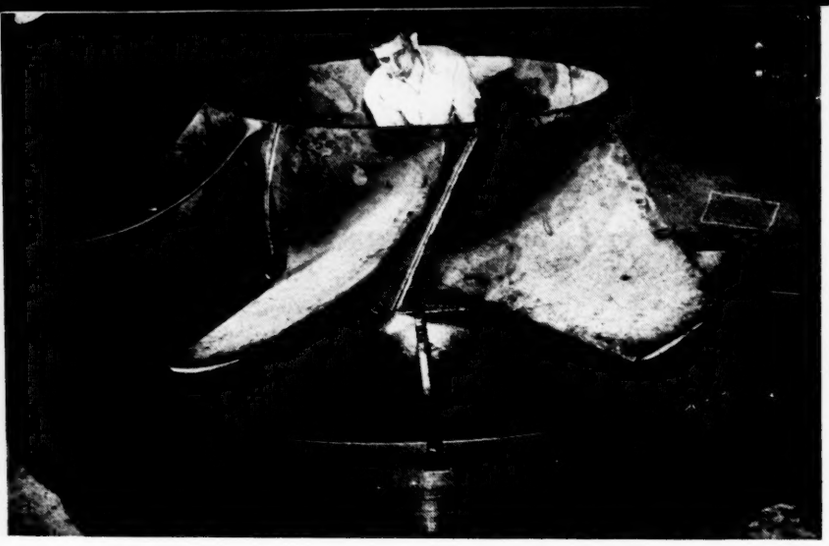
With large quantities of water this arrangement may cause excessive resistance to the flow of water through the coils, and to eliminate this possibility some manufacturers so arrange the tubes and headers that a double row of tubes, Fig. 8, is supplied from each header. An alternate arrangement to serve the same purpose is the use of 2-row straight tube sections with these sections connected in series.

Where very limited quantities of water are available and high temperature differentials between entering and leaving water are necessary it is possible to obtain coils which are so arranged that the water makes two passes across the face of the unit for each row of tubes.

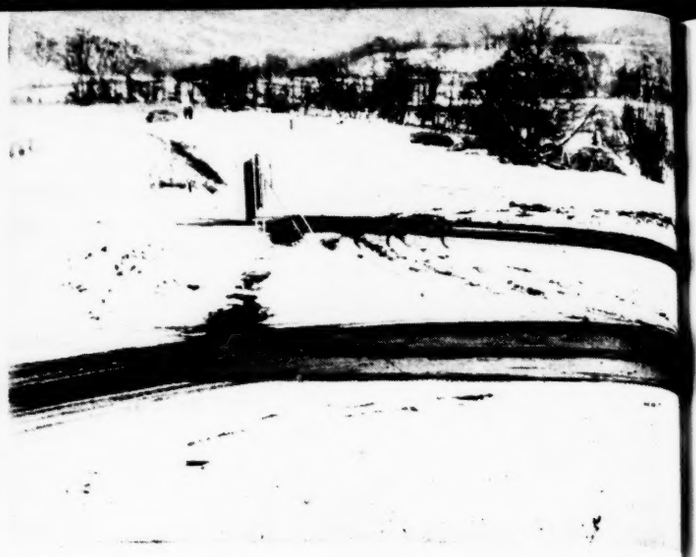
Where the water available for cooling may not be clean, or where brine is used, coils may be equipped with clean-out plugs at both ends of each tube, and on the headers to permit thorough cleaning at regular intervals.

Vents must be provided to facilitate removal of air when filling the coils.

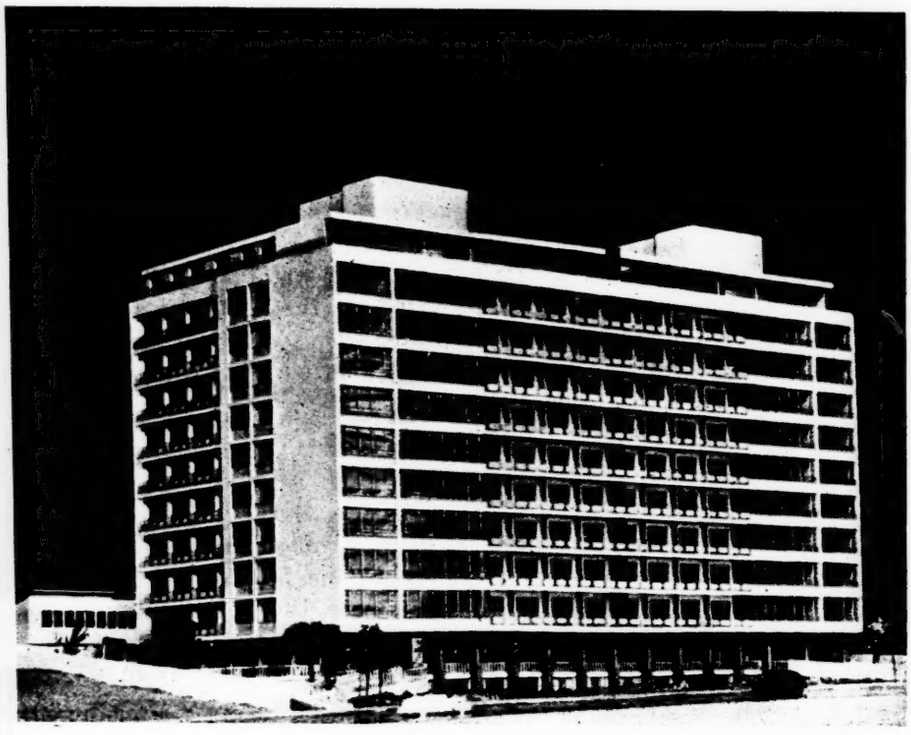
In order to eliminate the possibility of freezing in cold weather due to failure to drain all parts of the coil surface, one widely used make is equipped with drain headers between the inlet and outlet headers at each point, where, if coils are not set absolutely level, water could be trapped in the section. See Fig. 9.



This blower fan wheel, 9-2/3 ft in diameter, with 200,000 cfm low pressure capacity, is modelled after similar, smaller fans developed during the war for the Navy. This wheel is being re-engineered by the Sturtevant Division of Westinghouse Electric. Aluminum wheel was cast in 7 sections.



A snow-melting driveway, 600 ft long and two lanes wide, intersects the snow covered main road near American Cyanamid's Bridgeville, Pa., plant. Two runs of pipe under each wheel track carried water at 140F on this first trial and kept tracks clear at all times in a 2-in. snow fall.

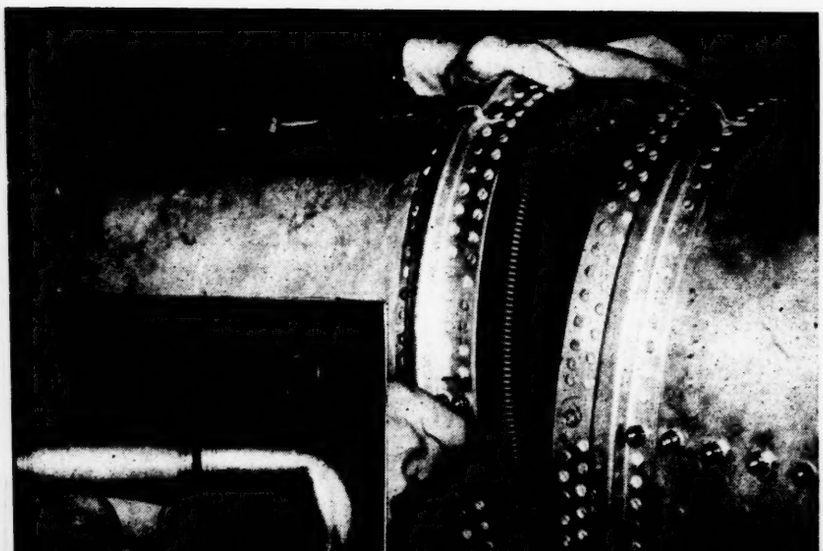


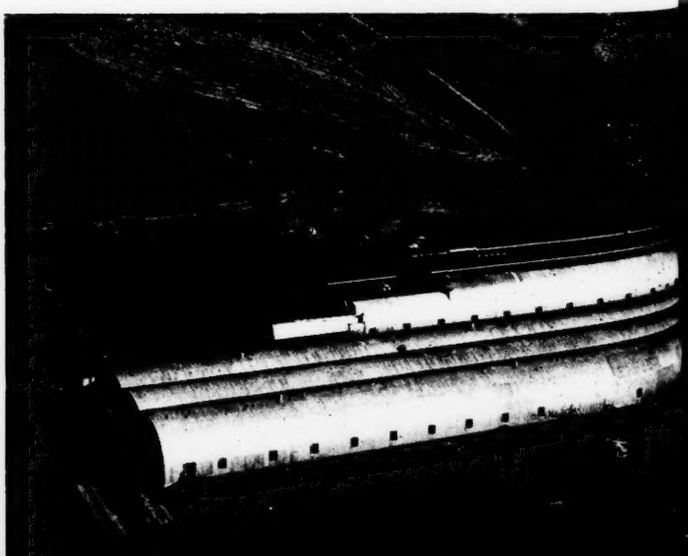
Picture Paragraphs

Prudencia Apartments now under construction in the fashionable Hygienopolis suburb of Sao Paulo, Brazil, will be completely air conditioned. Liberal glass area and many balconies take advantage of Brazilian sun. Basement is parking area for 40 automobiles. Architect is Rino Levi, and consulting engineer for air conditioning is Admiral J. Lomba. Apartment temperatures are individually controlled by 38 Trane Climate Changers while structures on roof house central heating and refrigeration supply equipment.

(Below) A pressure sealing zipper, unique device of rubber and metal manufactured by The B. F. Goodrich Co., is used to seal sections of the Supercharger air ducts of the Republic XF-12, Army 4-engine photographic plane. A commercial version built for civilians is called the Rainbow.

A novel Quonset-type factory being rushed to completion by York-Shipley to provide 60,000 sq ft of space until a permanent factory can be built. Principal product of Quonset plants will be oil-fired warm air units for veteran housing. Buildings are corrugated iron on steel frame.





Air Conditioning Design to Meet Current Material Shortages

BRUCE A. JACOBI
Chief Engineer, Lerner Shops, New York, N. Y.

Design practices of the Lerner Shops to avoid construction delays in the installation of air conditioning systems are presented in this article. It stresses importance of modified designs to meet present material and labor shortage, and the need for proper design to provide adequate and efficient maintenance.

THE second year of post-war construction finds the air conditioning design engineer greatly disillusioned. His dreams of mass quantities of new equipment, improved apparatus, an ample availability of labor, the elimination of all government red tape—all these have been shattered. Instead of such an Utopian outlook, the practical minded engineer has been confronted with an opposite reality.

Design is not the only headache confronting the engineer today. Maintenance, which is all too often passed off in a light vein, presents many a restless night for the conscientious engineer. Besides, there is the lack of immediately available strategic materials, such as compressors, bearings, motors, starting equipment and controls; the substitution of parts which are not necessarily interchangeable. These are just a few of the many items that necessitate a careful and diligent maintenance program if systems are to operate with a minimum number of breakdowns.

At present there is a strong tendency toward designing retail stores with large sales areas and utility rooms. This in turn results in increased sizes of air conditioning, heating and ventilation systems. Owners and managers, in an effort to employ better personnel, to increase their efficiency, and to retain their services for a long period of time, insist upon completely air conditioning all work areas. This not only greatly improves labor relations but results in a pleasant and cheerful spirit among the retail store staff.

Since most soft goods merchandise is perishable or is subject to spoilage caused by extremes in temperature and humidity, most modern retailers now know that a vast amount of spoilage can be prevented by storing merchandise in an air conditioned room. Danger of damage from insects is also checked. As a result, many merchants have been educated and now insist on air conditioned stock rooms, work rooms, and alteration rooms.

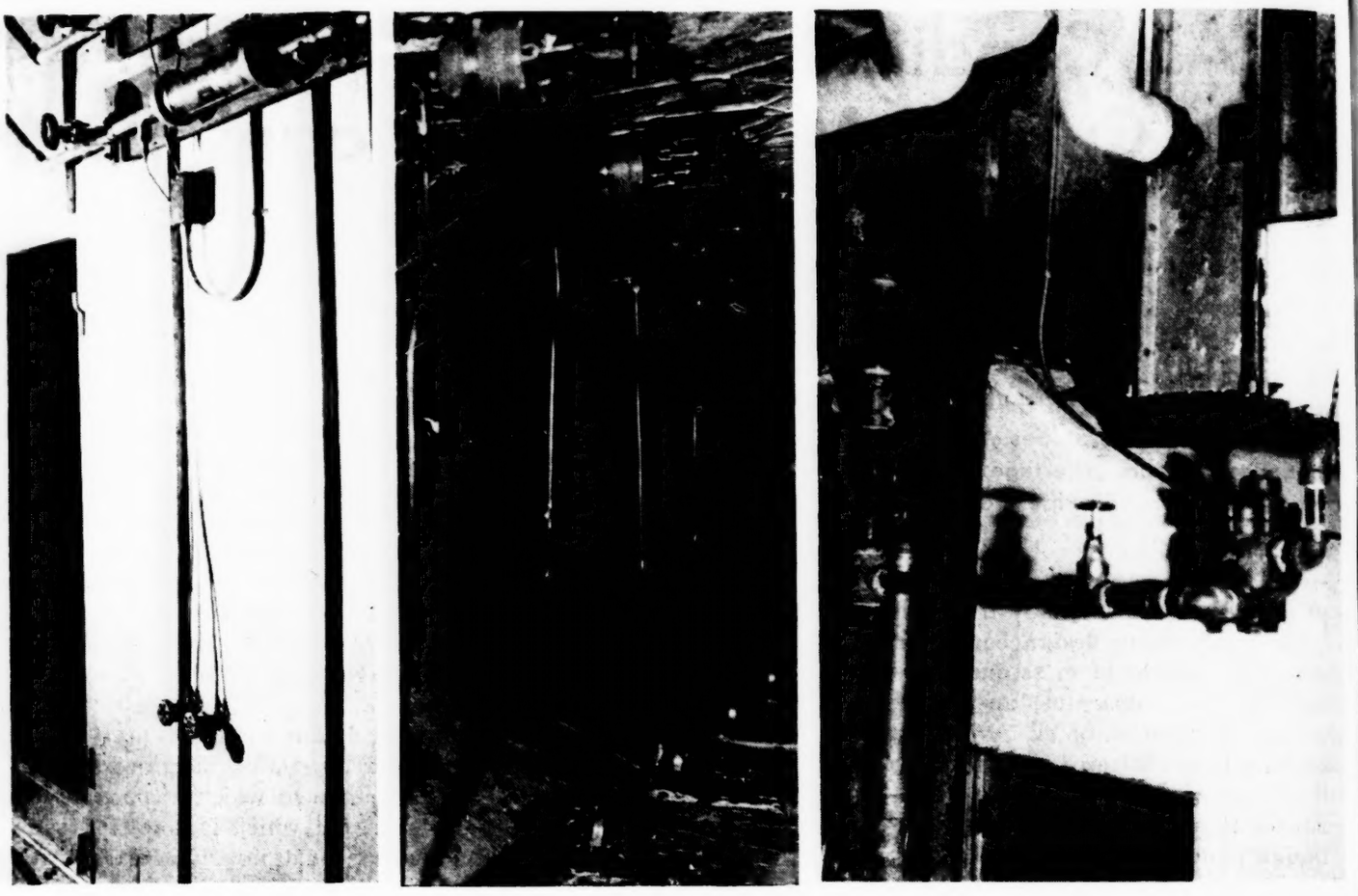
With the demand for larger systems, the design engineer today must meet such requirements plus the standards for a quality installation at a time when the market has a limited availability of air conditioning apparatus, scarce materials and a sparse supply of labor—all at greatly increased costs.

Nor are government restrictions completely eliminated. The Civilian Production Administration of our Government still controls authority to build. In many commercial building programs, the heating, ventilating and air conditioning elements constitute an important and sizable portion of the expenditure, and particularly in today's market, contribute greatly to increased building costs. The design engineer therefore should not completely disregard the fact that if a building is to be constructed in the very near future, C.P.A. permission must be secured. In the C.P.A. application, the amount of money to be expended plays an extremely important role.

Plans for mechanical details in this difficult era of today should be simple and practical. Engineers should not specify or design equipment which was readily obtainable before the war, but which is now practically unavailable. Engineers should investigate the availability of equipment and varieties of apparatus procurable before any specification is considered. Of what earthly use is an elaborately worded and carefully detailed specification when the contractor finds, much to his amazement, that the specified material is not currently available and cannot be delivered for several months—perhaps a few years? Another extremely important aspect of modern mechanical design is quality. With so much substitute material on the market, and with the out-cropping of new manufacturers as a result of the war, it becomes incubent upon the design engineer to carefully investigate new products and to rigidly specify those of superior quality only.

Every design engineer should be made to supervise his work in the field. Scarcity of labor, and in many instances, lack of properly skilled labor, can and does frequently result in the installation of a job unrecognizable to its designer. A few words and decisions from the engineer at strategic installation stages may often mean the difference between an excellent job and a haphazard, catch-as-catch-can installation.

It is my opinion that every design engineer should be made to live with the air conditioning system for at least six months after the completed installation. Too often designers fail to visualize maintenance. Utmost regard must be given to ease of accessibility of equipment, simplicity of operation, ready observation of machines, and above all, simplicity for overhaul and repair. For a system today to be practical and functional, simplicity is basic. All unnecessary gadgets which do no more than complicate systems should be eliminated even though theoretically they are sound and economical. A system should be so designed that a service man, of average intelligence, can diagnose trouble when it occurs. Such analysis and correction



(Left) Installation where provision is made for the future installation of an electrostatic air filter. (Center) Automatic damper control for hot and cold sections of a double plenum chamber. (Right) Simplicity of equipment in a double plenum system. Note only one heating coil and one cooling coil, with simple arrangement of piping and fittings.

are readily accomplished in a simply designed installation. Complicated appurtenances which the average maintenance man does not understand all too often cause him to lose interest in a system and make him assume that an expert or specialist will be called in whenever a breakdown occurs.

Equipment should be placed in a central location and, if possible, set on floors. Thus, maintenance and repair will be concentrated in one, and only one, area, enabling all equipment to be visible to the service man without the necessity of searching in remote areas for appurtenances. Adjustment and repair to valves, dampers, filters, heating and cooling coils, expansion valves, and strainers for cooling and heating systems are all contained within the limits of the apparatus room.

Thermostats, indicating temperatures of air being supplied to each zone, should also be placed within sight.

Pressure gauges should be mounted in conveniently accessible locations. Starters and switches, for fans and compressors located in the central area, render service in determining electrical difficulties.

To emphasize some of these points, here is a hypothetical example of what I have seen too often in some of today's engineering.

Let us assume a new store that has basement selling space, first and second floor sales areas, two separate fitting rooms and that the following conditions are to be maintained:

Summer—80F D.B. — 50% R.H.

Winter—72F D.B. — 30% R.H.

Outside summer conditions—97F D.B. — 75F W.B.; Winter—5F D.B.

The load based on lights, people, etc., amounts to approximately 80 tons of refrigeration and 30,000 cfm of air, with 6,000 cfm outside air for ventilation as a minimum.

Perhaps two 40-ton compressors, an evaporative condenser, direct expansion cooling coils, may be used. To do a superior quality job, there will be five separate zones with a separate heater and control to each zone. A central fan will supply the air and will be driven by a 15 hp motor. Provisions will be made to handle full outside air when permissible, and an electric precipitator will filter all the air. The ductwork casing will be all galvanized sheet steel of standard gauge to conform with accepted practice. A non-freeze heater under modulation controls the minimum outside air.

Cork insulation will be used on all ducts in unconditioned spaces and on all suction lines. Air conditioning equipment shall be located in a penthouse on the roof.

All equipment shall be interlocked electrically to be foolproof and automatic.

Pneumatic controls are to be automatic, with copper tubing used for the air line connections, and employing all the features of outside inside control, zone control, and control of the two compressors as the load demands.

In general this first quality air conditioning instal-

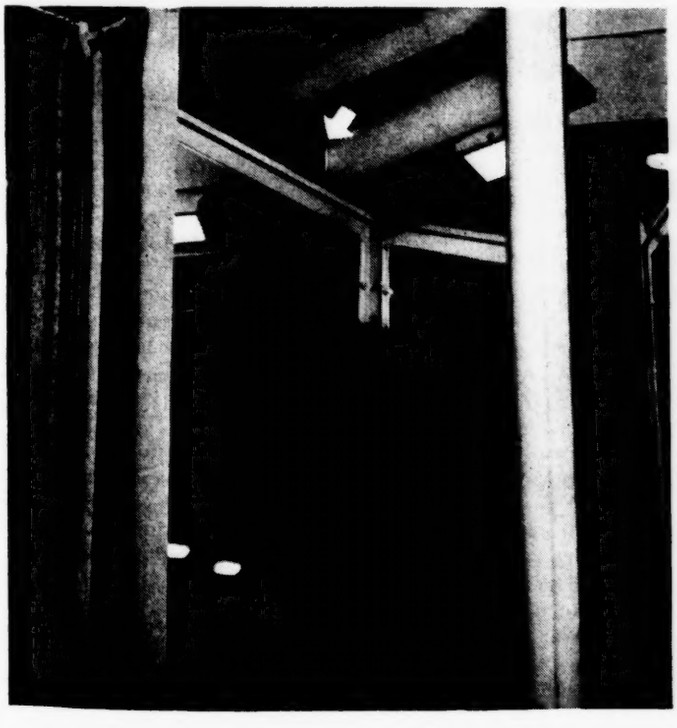
lation for all year round service will be supplied with steam from a central steam system available summer and winter.

To produce first quality air conditioning we know automatic control of temperature and humidity is a must. In a system having as many as five zones, it is concluded that there must be: A separate heater for each zone; separate valve for each heater; separate thermostat for each valve; separate hand valve for each valve and perhaps a separate by-pass around each valve; a separate steam connection to each heater; separate steam return from each heater; separate trap at each heater; a separate tailor made sheet metal connection to and from each heater; separate access door at each heater; separate hangers at each heater; separate ducts from each heater of specific gauge. G.I. Outlets of the draftless type, perhaps adjustable for distribution of air, will be installed.

Considerable time is spent in the preparation of plans and pains taken to see that all details are incorporated and shown. Specifications are written in which every known device mentioned is included so that the job, when let, will cover every conceivable item in keeping with good practice.

Now the job is ready for the launching. Plans and specifications with a request for bids are sent to several reliable contractors. Then the dark clouds begin to roll in. The engineer has assumed that prices will be in keeping with the general high trend and he has therefore allowed for it in his appropriation. He is not disappointed.

The proposal, written in great length, contains many clauses which convey the contractors feelings with respect to the unstable conditions of prices of materials and labor costs, and the fact that much of the specified equipment cannot be installed without a time delay. Upon further discussion with him, it becomes apparent that most of the quality features which are called for are not readily obtainable. At this point it is realized that a first class 1941 job has been designed for 1947 processing.



Arrow indicates thermostat, part of separate zone control for fitting room booths.

Substitute Material

Black steel heavy gauge sheet metal is now used for large casings and fresh air intakes. Angles for stiffening are thus not necessary and are eliminated. A painted coating developed during the war is used as a means of protecting the iron from corrosion.

An electrostatic air filter is a desirable and efficient accessory. However, due to prevealing conditions, the electrostatic filters not infrequently require a considerable length of time for delivery. This important aspect of design should not be eliminated by the design engineer, but rather he should anticipate the time of delivery and make adequate provisions for a future installation. The writer installs a bank of throw-away type filters in all current installations, but provides space for future installation of the electrostatic air filter.

Since cork insulation has been most difficult to obtain, the engineer must be willing to specify substitute insulating materials. It is extremely important that the substitute materials possess the desired coefficient of conductivity, and that they are fireproof, vermin proof and stable.

The five separate zones must be maintained for good practice and control, but this may be done with one heater instead of five, eliminating the multiplicity of heaters, valves, and control connections.

During the past year, we have found that a double plenum design renders simplicity, ease of installation, and flexibility of control with a minimum of hard-to-get items. The double plenum system allows for the use of one large cooling coil, and one large heating coil with a minimum number of expansion valves, modulating steam valves, and hand valves. Thermostats are used to control modulating dampers for each zone. While it is true that dampers were difficult to obtain, it has been my experience that many contractors were able to manufacture the dampers in the field.

Some of the phases of new equipment which will be forthcoming in the not too distant future are:

The possible use of improved and simplified compressors which I understand are being developed currently.
Cleanable type air filters of durable construction.
Plastic fan blades for small fans
Chemical dehydrators
Reversed cycle of refrigeration and heating.
Insulation of lighter and less expensive material, such as a current by-product of synthetic rubber.
Plastic piping for controls
Improved adjustable type air defusers.

These examples of substitution to expedite installation are but a few of the many means now possible. They are presented to show how it is possible to speed up construction work and how to avoid some of the many causes for delays in completing an installation.

Experience is my Classroom

By T. W. REYNOLDS

Editor's Note: This is the first appearance of what will be a monthly feature in HEATING AND VENTILATING. Mr. Reynolds, presently Chief, Air Conditioning Division, Abbott, Merkt & Co., Engineers, New York, has had an unusually varied career, a by-product of which are the accompanying notes and comments. These pages will range from opinion to anecdote, from homely philosophy to economics; some will have a moral, others not. Mr. Reynolds, you are now on your own!

NERVOUS NIGHTS

It was a nice estate located on Long Island Sound. The man of the house was usually the man somewhere else on business trips; his wife was elderly, nervous, and slept, not where she wanted to but according to the architect's graceful design, in a wing remote from the servants' quarters.

The continuous rhythmic washing of waves from Long Island Sound, punctuated by irregular snappings from the automatic heat, were the only noises that disturbed the silent nights. What could be done about it? Well, that was why the writer was there, to eliminate all noises that could be made by a thief in the night, but weren't.

During winter nights, the air valve on a radiator breathes and is identified by its click, but there are other sounds upon which you concentrate with no thought of sleep. A pipe takes up some slack or, finally, regretfully lets go of a piece of woodwork. The burner also quiets down, then suddenly the sheet metal front of a radiator buckles in a way that galvanizes you into action and brings you up ready to shoot at the whites of their eyes.

Curiously enough, these sounds do not affect everyone in the same way. One woman once told how she liked to hear them for she then knew that the heat was on and everything going satisfactorily.

Another woman could identify every sound as to its source and wasn't worried either, but just got fed up, as she said, with explaining to her guests that the tick, tick, tick in the wal's were creeping pipes. It interfered with card games and gave her house an inferiority complex, she said.

The lady of the house wants you to give the air valve a thorough going over. It hisses, spits and clicks in a disrespectful manner. You, however, pay no attention to it, but instead go down to the basement and there install a large quick vent air valve on the main, so that the radiator no longer takes all the air from the end of a main. Next, you set the house thermostat for a wider temperature differential in order to give sufficient time for the air to be driven out of the system.

As an alternative, or even a supplement, you increase the size of oil burner nozz'e and set the limit control higher. Quick recovery of the system will then eliminate the air head of thermostat cut-off, or the higher setting will raise more pressure to drive the air out.

Finally, you change all the rigid connections from branches to mains to swing joints and cut away some wood contacts. If some or all of these things do not give 100% satisfaction, then there is one other thing left to do.

This alternative is to install a night set back thermostat with a liberal set back. This will eliminate all noise, at least during the hours of sleep.

REAL STACK TEMPERATURE

The stack temperature of a given boiler is not always the same for the same output. If the fire is bright, the stack temperature will be lower for a given output than if the fire is b'ack on top due to the firing of fresh fuel. Stack temperature is, therefore, not always a guarantee of boiler performance.

If the mixture of gas and air is not good, the gases may not burn until they enter the smoke pipe. The size of boiler flues, number of turns in the gas travel, temperature of the firebox, and the setting of the primary and secondary air dampers are some of the items which determine singly or together whether the gases will burn in the stack.

Leaks of air into the boiler (especially near the end of flue gas travel), or in the smoke pipe, lower the apparent stack temperature. To be certain that no leakage is taking place is quite difficult, but one thing is certain: the farther the reading is taken away from the boiler the lower the reading will be.

SAVING FUEL BY USING MORE

The boiler doesn't get up pressure—that is the comp'aint. You have been there before to prove that it can, but the owner complains that it only works when there is an engineer around and adds that he is no engineer. This time you get him to join you in the cellar, offer him a cigarette and start to fill up the fire pot with many a shovel full. His attention leaves the fire and becomes focused on the gap just made in his coal file. Therein lies his trouble. His attention has always been no the coal pile rather than on the fire. It is explained to him that one can save coal by using more, but he has his doubts.

A thin fire has to heat a lot of excess air, has no constancy and cannot be controlled, whereas the fire in a heavier fuel bed can be controlled up or down, given adequate draft. The live coal contact with water-backed surfaces can also be increased. Each time that a boiler is fired there is a loss due to cold air entering over the fire and the blanketing of a radiant fuel bed.

Round boilers give most surprising results when heavily fired, particularly those with but few sections. The path of the gases in such boilers is usually too short and direct. Making full use of the primary surfaces by live coal contact is the answer.

SAVING FUEL BY USING LESS

With oil, as a general rule, one can cut down on the nozzle size and save oil by doing so. With the smaller nozzle, the heat absorption will be greater and the stack temperature lower while any combustion noise will be reduced accordingly. The burner will be on longer, possibly five minutes more, during which time the stack loss continues, though with a lower stack temperature, and with less time for standby losses from stack and setting.

The oil burner dealer tends to put in too large a nozzle because there are more complaints from underheating than from lack of economy, but where there is a limit control to maintain the boiler water temperature, the pick up is rapid enough. The nozzle size is based on the installed radiation, but the user does not always have all of the radiators on; furthermore, the actual load may be less than the connected load. The connected load becomes the actual load only if the

user opens the windows when there is overheat.

Still another factor tending to oversize of burner nozzle, is the full addition of the hot water load to the direct radiation load. Hot water is not only heated as the burner runs; heating depends upon circulation and goes on most of the time, being deductible to a considerable extent from the standby losses.

ARCHITECTS vs. ENGINEERS

Over the years the architect has won out in the friendly battle with engineers over the concealing of mechanical services. Utilities once both seen and heard are no longer in evidence in either respect. Radiators, for example, have progressed from ornate, to plain, to concealed, and in some cases to oblivion.

Some engineers never could yield; in their opinion there was but one place where a radiator or duct outlet could be located, while some architects never could design around a mechanical contrivance and blend it in with the decoration. The utility just had to be moved from wherever it was to wherever they wanted it.

One architect of broad perception once said that he couldn't argue with an engineer because the engineer had the mechanical advantage over him, but that he somehow felt that, given the added knowledge of an engineer, he could contrive to make a utility function and at the same time make it less obtrusive.

How much the mechanical services of a building should be subordinated to the architectural requirements depends a lot upon where you are employed, whether by an engineer or architect; where the functions are combined, it may depend on whether you work for the architect-engineer, which is one thing, or you work for the engineer-architect, where there is another point of view.

In Washington there were many architects in the War Production Board, so that it was not a difficult matter to get a lively discussion started whenever the foregoing views were given an airing. The writer on one of these occasions produced an old rib, in which an architect is defined as one who thinks you can get a 6-inch cast iron soil pipe in a 4-inch partition and conceal it. This sort of thing was usually a clincher, but on this occasion one architect said, "That is correct, and what's more we are the boys who can do it." The writer is beginning to believe that they can.

Nevertheless, there does seem to be an overdose of the architectural with certain architects. They certainly have a dislike of chimneys, not so much because of the space they take up, which they may grudgingly grant, but rather of that particular part which is above the roof.

The first thought of the engineer is to get the chimney well up above the roof. The first thought of the architect when he sees it for the first time on a plan is to get it down below the roof, or coping, or hide it back of a sign or penthouse. Just the same, through Connecticut there are some old completely exposed industrial chimneys, more or less covered by vines. Perhaps such chimneys are symbolic of industry and as such are art.

Just about the time that Canada entered World War I, the writer sojourned for a time in Toronto. The basement grille room of the King Edward Hotel was the usual place for luncheon, in company with a number of architects. The writer liked to ask them what they could find wrong with the basement treatment. When they could find nothing, a 10-inch steam pipe would be pointed out, a pipe which had been run the full length of the ceiling, then insulated and painted to match the environment. "What a beastly thing," they would exclaim. The writer knew he was licked.

From the writer's office on the 20th floor of a building on 40th St. he can survey adjacent buildings of various types of architecture. The more ornate they once were made, the worse they look now since they have aged. Perhaps more people have studied on the architecture of the tops of buildings during the design stages than have ever noticed them as built. If a photograph were taken of the upper halves of these buildings would there be any architect who could tell you where they are located—or could anyone else do so?

The writer thinks back to one of the buildings at the 1939 World's Fair. The architects just didn't want any outlets for air in the ceiling, but the writer, recalling one or two headaches when using side wall outlets in the same Fair, was just as set in his own way. The matter went to the management for decision with the result that the outlets were to be overhead.

Now there is no one who can beat an architect when it comes to designing around something he is finally persuaded can't be moved to some other place. In any event, the architects went to work, combining several of these outlets (see photograph) in a rectangular cove with half circles at each end and blended the lighting in and rested, proud of their work.

The glory for this treatment passed from the writer's hands into those of the architects, but he is as satisfied as he is about some of the things he battled for in the design of his own home. The architect in this case was an old friend who, having passed on, can't defend himself now. This architect used to show others around this home and take credit, absent-mindedly for the things for which the writer had earnestly contended.

A directors' room is one of those things that an architect goes to town on. A fan must not be over it on the floor above, nor under it on the floor below, nor anywhere near it. Somehow the darn room always seems to be located in the most strategic spot for an apparatus room. Recently in a directors' meeting the writer finally spoke his mind and said he could see at least a dozen possible locations for the new directors' room other than the one fixed by plans. Much to his surprise the chairman of the board said, "I am with you 100%; I never wanted the room there in the first place."

In this World's Fair Building the architects successfully made the air diffusers part of the architectural design. Illustration courtesy Anemostat Corporation.

MOISTURE IN FANS

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A young man ponders on this and says "You talk about velocities whereas most pipe tables give pipe sizes according to the pressure drop, but why not according to velocities." You reply that the pressure drop method is better understood or rather applied, because it tells you that a certain initial pressure must then be carried at the boiler.

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While he is doing that, the writer can point out that it is not so much the commercial pipe sizes that upset refinements of calculations as it is the lack of reaming. Exact and odd sizes of pipe, valves, fittings, specialties and insulation would cost too much to produce, handle and carry in stock, just for a questionable refinement.

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Having by devolution worn down a tooth as a receptacle for the pipe, having smoked at all times everywhere, and having done this even in the bath tub where quick submergence was sometimes required to duck a hot ember, what could be more satisfying than to add a powder magazine at Sandy Hook to "List of Places I Have Smoked In." The lieutenant who was showing the writer around started this by lighting a cigarette and was socially joined, for after all two fires are not as efficient as one.

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An estimate for the proposed system was made. It was over the government appropriation. Now here and there about the grounds were unused boilers in old buildings and in one of these buildings a boiler of suitable size for the magazine was found and reported to the lieutenant, so as to keep within the appropriation. The lieutenant shook his head sadly and said "No, that boiler is on government inventory and only an act of Congress could remove it."

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Precautionary measures vary with the use to which a structure is put. Some buildings must be kept above the freezing point, but cannot have heat applied internally. It might be possible to shine the heat in through a window by means of lamps, but even this is ruled out because of dangers from radiant heat. So, strangely enough, these places were heated by cold water. Heat losses were minor, the buildings being half buried and heated only to just above freezing. Water set to flow in a trough at a sufficient rate gave up the necessary heat.

Two different elements that make up explosives may be innocent enough in themselves; brought together they are temperamental and dangerous. They are mixed in one building by manipulating wires from another building. Precautions given you as to design are so many that one is disappointed if there isn't an explosion every other day and there aren't many just because of these precautions.

Production in ammunition plants fluctuates widely due to demands equally as variable, so design in such places did not progress rapidly until World War II when new plants were built. New ideas came along. Why not enclose one of the small structures in a cage of expanded metal to confine exploding parts. This was done in one case and a test was awaited by natural means; it might be a day or a year till it came. It came within a week, confined the parts as expected, expanded the expanded metal enclosure to grotesque shapes and left an exploded view of a dismantled heating system.

To certain structures one man brings one part of the ultimate mixture, from another storage place by another direction comes another man with the other part. They must not meet so as to collide in the pathways between earthworks and make a premature mix. What could be better than a photoelectric eye to ring a bell or provide some other form of warning. Those in the know said no. In vain you argued the unfailing operation of the eye. "It's a gadget," they said, "and the powder business can not depend on gadgets. We will continue to operate as before, each man to whistle his approach as a warning to the other."

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As for the range itself, it must have ventilating ducts quickly to remove the smoke and the dust from chewed up concrete for a bullet in a firing range strikes and then goes around like a mad bee. So exhaust ducts must be of $\frac{5}{8}$-inch boiler plate with inlets in most unlikely places for a bullet to find and with enough turns to tire the bullet out if one does enter a duct. Lights and sprinkler heads must also be concealed.

The firing gun is in a door and arranged so that the gun can be fired only when the door is closed. Various other precautions are taken, for the man at the gun is monotonously firing all day. It's just routine, he pulls a rope down and the gun fires. You go inside with fear and trembling, for a machine gun had just been fired with so much vibrations that a lot of pipe on pegs along the wall abruptly clattered to the floor. Down at the target you take a measurement, then forget what it was as someone lets go down the adjacent firing range.

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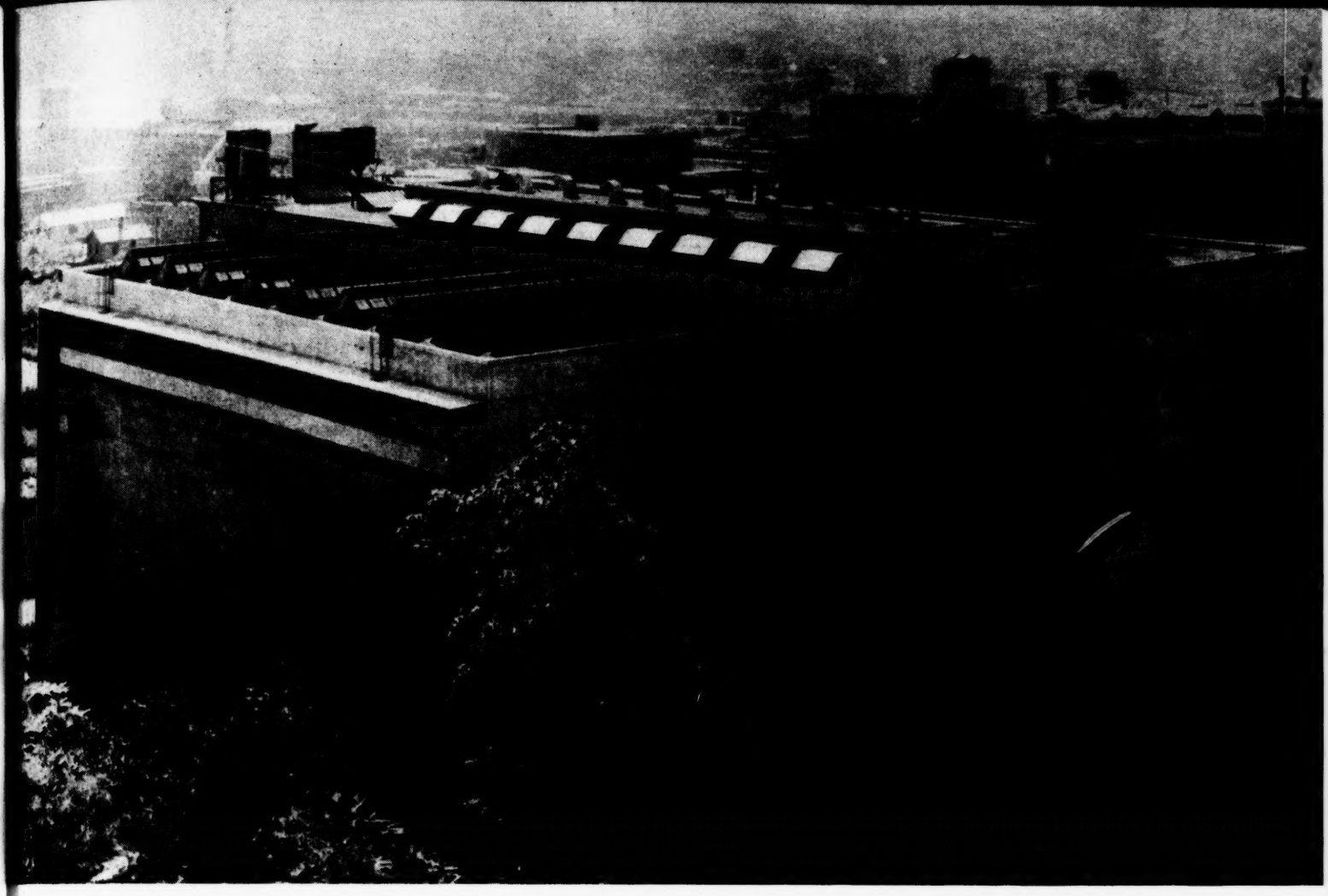

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Formerly the linoleum from the manufacturing buildings had to be cut and handled in rolls for transfer to the stove building. The new design thus obviously eliminates a considerable time and cost factor in materials handling and facilitates production of linoleum with a high standard of surface smoothness.

The stove building, which consists of a series of huge curing ovens, is in two sections, a design evolved by Albert Kahn Associated Architects and Engineers, Inc., to take advantage of a sharp grade for additional floor space. Over-all dimensions are 133 ft by 214 ft. Of the 214 ft, 35 ft consists of a multi-storied structure with six floor levels and a height of 72 ft from grade to roof. This section is reinforced concrete beam and slab construction with brick facing and steel sash. Its principal function is to facilitate the movement of linoleum rolls from the stoves to the examining building. The rolls are taken from the stoves at the top floor level, lowered by a 6-ton elevator in the multi-storied building to grade, and thence transported by rail car to the examining building.

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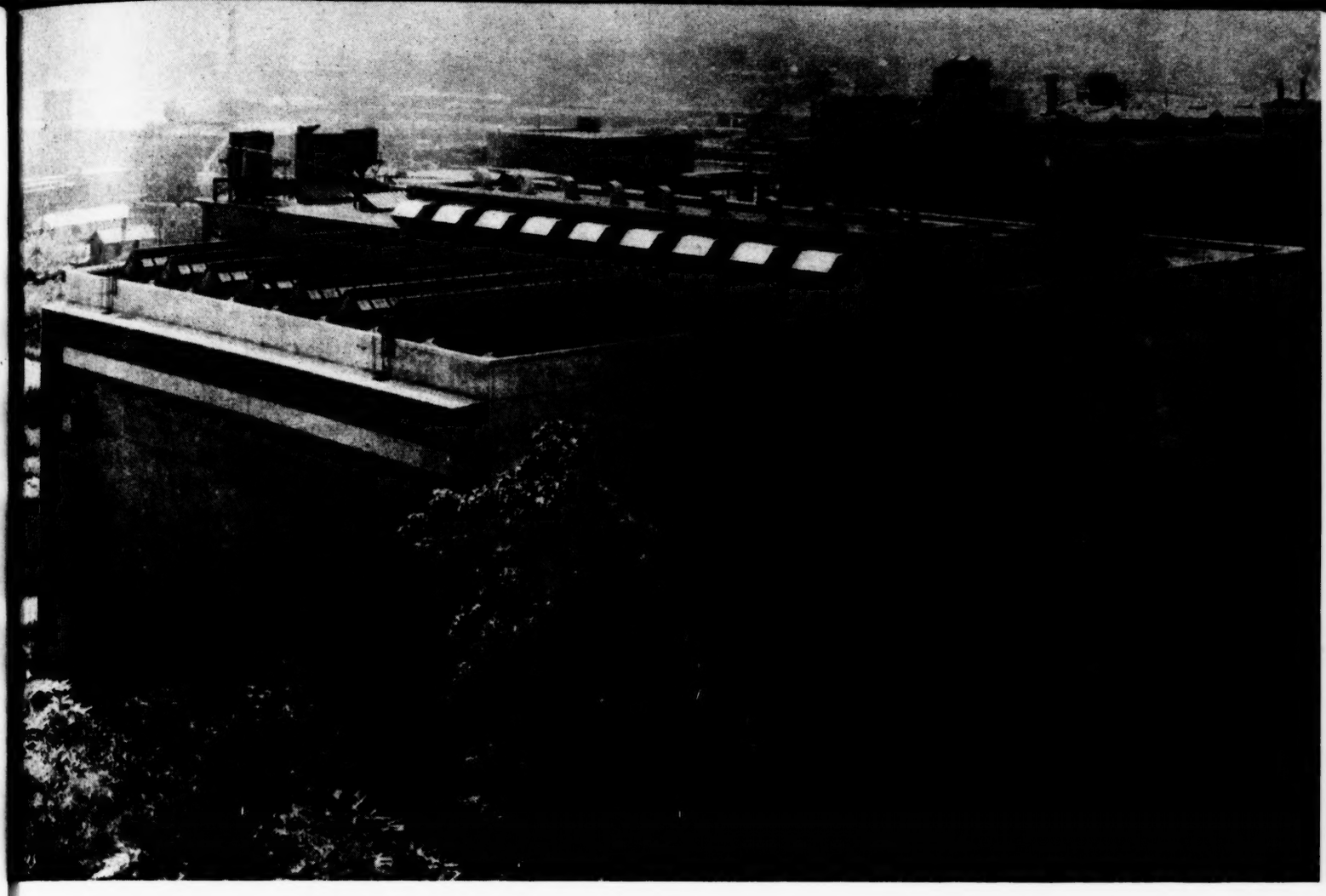

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Architecturally, this exterior wall depends upon concrete form treatment almost entirely. Forms are placed vertically at the grade, with alternate smooth and recessed horizontal bands indicating floor levels.

These exterior concrete walls are eighteen inches thick, a type chosen to withstand both wind load during construction and operation, and the full weight of process material and equipment.

The material comes in a continuous band from the manufacturing building through two 15-ft bridges, one 50 ft long and the other 37 ft, containing conveyors which enter at the fifth floor of the stove building. Both ends of these bridges are protected by fire doors, and here it should be emphasized that every feasible safety precaution against fire or explosion has been taken throughout the new projects.

Material as it is received from the manufacturing building, already inlaid and of standard linoleum thickness, is conveyed by a loading machine, on trackage, to the oven to be filled. This material is suspended in loops or festoons from batten rails down to the floor about 50 ft below.

The ovens, or stoves, are formed by solid concrete walls and extend the full depth of the building. Each one of the ovens is independent of the other eight. Each has its own electrical controls, ventilating system, and separate monitor opening at the top.

After a cell is loaded, the monitor and doors are closed, the heat is turned on, and the material is started on a curing or oxidizing cycle averaging about 30 days. At the end of that time, the process is simply reversed for unloading, except that whereas the cells are loaded from the fifth floor, they are unloaded on the sixth floor to avoid confusion. The material is rolled and cut into 1,500-ft lengths. From the sixth floor, the rolls are moved by industrial car down the elevator and thence by rail to the examining building.

Experience has shown that oxidation in the stoves is best achieved at a constant temperature above 160F. To maintain this temperature in the stoves while a thermometer outdoors may read zero or lower in the New Jersey climate necessitated provision for expansion joints along all the exterior walls. Similarly provision for expansion and contraction of the interior walls was planned because one stove might be heated to a high temperature with the adjoining stove normal for loading or unloading.

Time economies effected are principally in cooling and emptying each stove after the curing process is complete. Without forced ventilation several days elapsed after the opening of a stove before men could enter to take the material out, the principal deterrant being the residual heat in the walls of the stove and its contents.

To meet these conditions, the new design specifies a 40,000 cfm axial flow exhaust fan which draws air from the center of the opened stove and discharges it vertically into the atmosphere.

To overcome residual heat in the walls and provide tolerable working conditions for the men inside during both emptying and filling, a blower type fan with a capacity of 25,000 cfm is provided for each stove, with two jet cooling ducts located at the ceiling along each side wall and with jet outlets directed toward the working galleries near the top of the stove.

A penthouse running across the center of the roof above the stove houses all ventilating equipment. Each stove has its own complement of fans.

Inspection doors are provided at both ends of each stove. To obviate the need for workmen to enter the stoves during the curing process at frequent intervals, electric eyes are specified at the floor level, one at either end of the building. Any break in the light beam caused, for example, by a loop of lineolum falling to the floor would set up an immediate alarm. Numerous recording instruments are also installed on each stove.

Each has an exit door at the top floor level opening onto a balcony which extends the full length of the building, with a cantilever type balcony at the rear connecting by a canopy-protected stairway to grade.

The first floor of the building contains the examining tables and final packaging, while processing operations are carried on at the second floor level. Both floors have presently unoccupied space for future expansion. All major areas on both floors are individually contained so that any one of them may be air conditioned if desired.

Rolls are unwound and run in a continuous band through various finishing machines. Fumes and heat emitted during these processes posed problems not only in cooling and ventilation, but also led to extraordinary precaution against fire and explosions. Stacks from the area connect with roof openings, and sidewall glass is scored to relieve internal pressure if necessary.

The processing areas on the second floor, the examining section and an adjacent unassigned area on the first floor are each equipped with a separate hot blast, central heating and ventilating system arranged for future cooling coils and designed to take in all outside air for mid-season cooling and for about 75% recirculation during the heating season. Overhead construction in these areas is solid slab, with floor to floor spacing of 14 ft. Ducts are designed for minimum clearance of 10.5 ft. Air from the first floor sections is vented into the high, roll-storage bay whence it is exhausted by mechanical roof ventilators.

Other areas are heated by vertical projection unit heaters, with blower type unit heaters for air screening the large doors in the roll storage area, direct radiation being provided in smaller rooms where suitable. Sufficient air is supplied by the blast systems to prevent temperature rise in the various departments more than 5 to 10F above outside temperatures.

There are foremen's rooms in various parts of the examining building, and one end of the first floor is given over entirely to employee facilities. There are individual lockers, toilets and the customary facilities, as well as rest rooms and showers. Hot water is provided by steam surface, instantaneous type water heaters located in the toilet rooms.

Both of the new Congoleum-Nairn buildings were among the first off the design boards of Albert Kahn Associated Architects and Engineers, Inc., for postwar civilian production. Turner Construction Co. is the general contractor. The project embraces, in addition to the stove building, a new examining building.

Temperature Distribution in an Experimental Low Cost House

RICHARD S. DILL and PAUL R. ACHENBACH
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In this conclusion of a two-part article, the authors report horizontal temperature differences observed in the experimental house with various heaters, and also a general discussion of results is presented.

THE vertical temperature differences between levels increased as the outside temperature decreased with all the heating devices tested. The variation in the vertical temperature differences with outside temperature for five heating systems is shown in Fig. 9. Data were obtained for a sufficient range of outside temperatures to show the trend. It will be noted that the gravity hot water heating system produced the smallest temperature differences between levels throughout the range of outside temperatures shown. The heat released in the basement by the boiler, piping, and smokepipe was probably influential in keeping the temperature differences small. When the gravity hot water system was used, the temperature in the basement under the floor joists was 75F when the outside temperature was 19F. The heat transfer through the wood floor was in an upward direction for this system.

Two other interesting results are shown in Fig. 9. The vertical temperature difference was less between the 2-in. level and the 60-in. level, for outside temperatures of 35F or lower, with the electric heater having gravity circulation of air through a plenum, than with either the lectric heater or oil-burning furnace having forced circulation through the same plenum. The difference is attributed to the larger amount of radiant heat from the ceiling due to the higher ceiling temperature attained with the gravity system.

Vertical temperature differences between the 2-in. and 60-in. levels produced by the gas space heater with a disc fan were substantially equal to those observed for the oil-burning furnace with the plenum distribution system.

Horizontal Temperature Differences. The results showed that the average of the horizontal temperature differences at all levels of measurement ranged from 2 to 4F for the several floor furnaces and for the gravity hot water system. The horizontal temperature differences obtained with the electric heater and the oil-burning furnace, when attached to the plenum chamber, were nearly as small for the levels 2, 30, and 60 in. above the floor as for the above-mentioned devices, but they were substantially greater in the upper levels in the house.

As would be expected, the temperature difference between rooms was greater for the space heaters located in the living room than for the other heaters tested. This effect can probably be attributed to the fact that the rooms other than the one containing the heater are warmed by the overflow of heat from the living room through the doorways. If there were no temperature differences between rooms, there would be no motivating force for air circulation.

Later tests have shown that the temperature differences between rooms can be decreased by the use of a fan on or near a space heater blowing toward another room. The temperature difference between rooms was increased at the 2-, 30-, and 60-in. levels by the fan on the oil-burning heater used for these tests. This fan discharged air near the floor but was not directed toward a door.

The results showed that, except for the space heaters, the average horizontal temperature differences from 2 to 60 in. above the floor did not increase with lower outside temperatures. When the bungalow was heated with a space heater located in the living room, the temperature difference between rooms usually increased somewhat with decreasing outside temperature.

Discussion of Results

It was noted that the vertical temperature difference inside the Test Bungalow increased as the outside temperature decreased. To determine whether or not the temperature difference between the floor and the 5 ft level was proportional to the difference between the inside and outside temperature, a tabulation was prepared evaluating the ratio of these factors for several days of operation with some of the heating devices tested. The temperature difference between the outside air and the air inside the laboratory at the 30-in. level was designated as DT_1. The 30-in. level was chosen because the room thermostat was located at that height and because it was the midpoint between the floor and the 5-ft levels. The temperature difference between the air 2 in. above the floor and 60 in. above the floor was represented by DT_2. When the term $\frac{DT_2}{DT_1} \times 38$ represented the temperature difference between the floor and 5 ft levels for a 38F temperature difference between inside and outside, i.e. for an outside temperature of 32F and an inside temperature of 70F. The average values for the term $\frac{DT_2}{DT_1} \times 38$ are given at the bottom of Tables 1 and 2. (H&V:2:47: pp 68 and 70)

If the temperature difference between the floor and 5-ft levels was directly proportional to the difference between interior and exterior temperatures, the ratio of DT_2 and DT_1 would be constant. Then the value for the temperature between the floor and 5-ft levels corrected to an outside temperature of 32F would be the same no matter what the outside temperature was when the observations were made. The results obtained by these calculations show that the quantity $\frac{DT_2}{DT_1} \times 38$ was not constant, but that with some exceptions its value remained reasonably steady during the use of any one heating device.

For the electric heater, the value of the quantity $\frac{DT_2}{DT_1} \times 38$ averaged 10.5F with continuous forced circulation of 1,460 cfm of air; for the hot water heating system it averaged 5.7F, and for the oil-fired warm-air furnace, 19.1F. It will be noted that the averages for the ratio $\frac{DT_2}{DT_1} \times 38$ agree closely with the values for the temperature difference between the 2-in. and 60-in. levels at an outside temperature of 32F indicated by the curves on Fig. 9 for the corresponding system.

No significant correlation between the value of the quantity $\frac{DT_2}{DT_1} \times 38$

†The National Bureau of Standards is a fact-finding organization; it does not "approve" any particular material or method of construction. The technical findings in this series of reports are to be construed accordingly.

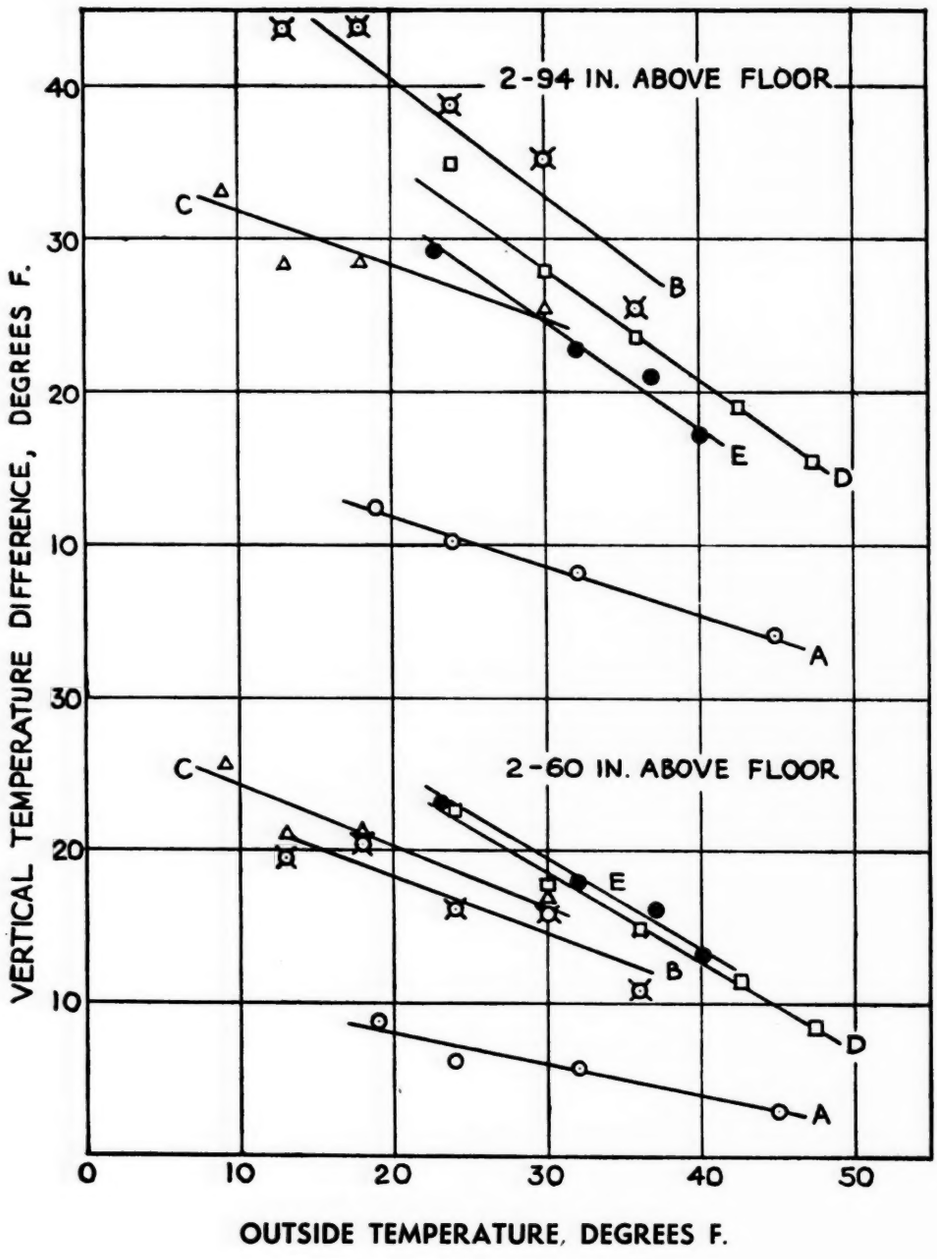


Fig. 9. Vertical temperature differences attained with various heating devices in the Test Bungalow at the National Bureau of Standards. Upper curves show differences between temperatures at 2-in. and 94-in. levels, lower curves between those at 2-, and 60-in. levels.

A. Gravity hot water heating system with radiators.

B. Electric heater with gravity circulation through a plenum chamber.

C. Electric heater with forced circulation (780 cfm) through a plenum chamber.

D. Oil furnace with forced circulation through a plenum chamber.

E. Gas space heater with a disc fan.

and the prevailing weather nor with the wind direction or velocity were found, even though it was expected that a strong wind would produce a greater temperature difference between levels in the structure because more heat was required.

Consideration of the methods of heat transmission from a house suggests that the temperature distribution produced in a house by a heating system depends not only on the design of the heater and the distribution system, but also on the construction of the house. It is considered probable that the vertical temperature differences and, to some extent, the horizontal temperature differences produced by a given type heater and heating system will depend on the materials used in the walls, ceiling, and floor, the amount of insulation used in these elements, the amount of window area in the house, whether a basement or crawl space is used under the house, whether or not all of the rooms are on one floor, the arrangement of the rooms, and perhaps other factors.

Certain types of heaters may be suitable for houses of one construction and not suitable for other constructions. For example, a high temperature near the ceiling would not cause much additional heat loss if the ceiling were well insulated, or an insulated floor might permit the use of heaters that do not deliver warmed air at or near the floor level. Furthermore, some types of heaters that provide comfort in areas where extremely low temperatures do not occur, may not provide comfort in colder climates.

The data reported herein were all obtained with the same wall construction, the same degree of insulation, and the same arrangement of interior partitions, so that the data are directly comparable. Data on the effect of wall insulation, floor insulation, weatherstripping, storm windows, and other variables on the temperature distribution, are needed to provide a complete study of temperature distribution, but these phases of the subject were not taken into consideration during the present program. It is probable that lower temperature differences than those reported herein can be attained with the same heaters in houses of different construction and that a wider variation in temperature might be produced in other houses.

No standards of vertical or horizontal temperature differences in residences have been suggested or established. Observers engaged in these tests agreed that the air temperature at all points in the living zone of all rooms should lie in the range from 65F to 80F for comfort when heated by the conventional types of heating systems or devices.

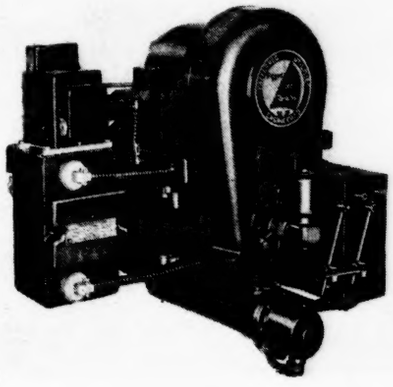
A floor temperature of 60F, when continued for 1 hour or more, was found to be too low for foot comfort; when a floor temperature of 65F was continued for the same period, discomfort was no longer apparent. It was further observed that air temperatures of approximately 85F around the level of the head became oppressive, especially if the air had an appreciable velocity. Of course, variations in the humidity of the air and the presence of a large amount of radiant heat or a large amount of cold window surface might alter these conclusions.

The test results obtained with the devices used in the Test Bungalow indicate that further improvement in the design of house construction and heating systems is necessary to provide comfort in all rooms of basementless houses. A more nearly uniform temperature distribution can probably be obtained either by the use of more insulation in the house elements, by improving the heat distribution systems, or by a combination of both.

NEWS OF EQUIPMENT AND MATERIALS

Heavy Oil Burner

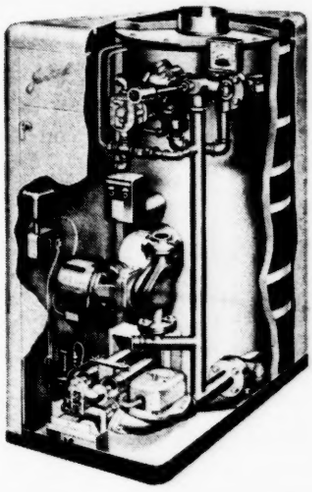
NAME—Preferred heavy-oil rotary burner.
PURPOSE—Oil burner for No. 5 or 6 oil.
FEATURES—Throttle control of air valve in combination with the Vo-ul valve permits accurate proportions of air and oil for efficient combus-



tible mixtures. Voluvalve exactly meters a predetermined quantity of residual oils regardless of changes in temperature, pressure or viscosity. Burner has two submerged pumps, one for suction, the other for discharge. An electric heater in the reservoir keeps the oil in the reservoir and cored passages in the burner at the proper temperature.
SIZES AND CAPACITIES—Available in 36 different sizes and combinations from 12 to 150 gpm.
LITERATURE AVAILABLE — Bulletin No. 175.
MADE BY—*Preferred Utilities Mfg. Corp., 1860 Broadway, New York 23, N. Y.* **345**

Water Heater

NAME—Janitrol triple service hot water heating system.
PURPOSE—For providing hot water for three different temperature demands such as for comfort heating, high temperature water for automatic laundry and dishwashing, and tempered water for tub and shower.
FEATURES—Boiler proper complies with ASME standards for steel heating boilers and is constructed of ¼ in. steel boiler plate. Top tube and crown sheets are made from 5/16 in. steel. Fire tubes are of 13 gauge standard boiler tube steel. Heating plant comes completely assembled and wired, ready to run. System comes with set of carefully sized room heat transfer units, tubing, fittings and suitable controls. Pilot gas regulator is standard on all models. Will not be in production until late in 1947.
SIZES AND CAPACITIES—WAS-100-64 with an AGA rated input of 100,000 Btu per hr; WAS-150-64 with an input rating of 150,000 Btu per hr;



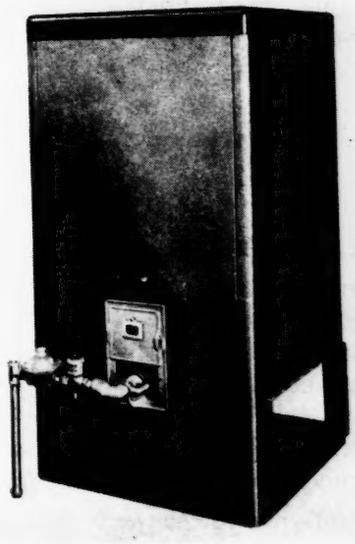
WAS-210-64 with a rated input of 210,000 Btu per hr.
LITERATURE AVAILABLE—Illustrated booklet.
MADE BY — *Surface Combustion Corp., Toledo 1, Ohio.* **346**

Plastic Coated Pipe

NAME—Plastic coated steel pipe.
PURPOSE—Pipe for oil well drilling resistant to corrosive conditions.
FEATURES — Coating is applied to the inside of the pipe only, and before the coating is placed, the inner surface is first shot-blasted. Pipe is upended on a rack and liquid plastic is forced up on the inside of the pipe until it reaches the top and then the liquid plastic is drained slowly so that no air bells or streaks result. Following a period of drying, lengths of pipe are placed in an oven, and the coating baked. Pipe has four successive baked coatings. Tests have shown that plastic coating will prevent pipe failures during drilling by protecting the inside surface of the pipe against pitting. Pipe turning in the hole being drilled keeps the outside surface burnished and free from corrosion. Experimental work is being carried on to adapt this type of pipe to other fields.
MADE BY — *Spang-Chalfant Division, The National Supply Co., Pittsburgh 30, Pa.* **347**

Gravity Furnace

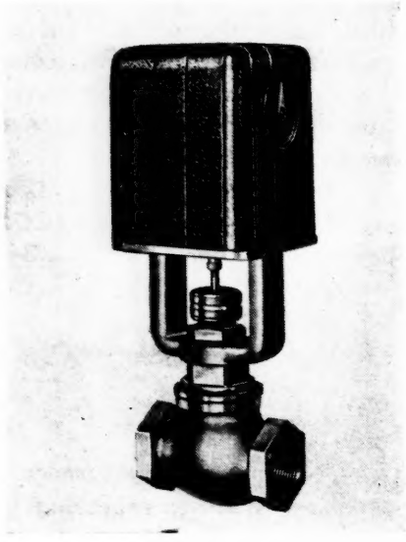
NAME—Norman gravity furnace.
PURPOSE — Warm air heating by means of a gas-fired furnace.
FEATURES—Controls include ¾ in. magnetic gas valve and transformer, thermostat, gas pressure regulator, automatic electric safety pilot, large



hand shut-off valve with pilot cock. No. 11 gauge furnace steel completely welded and assembled is used for the combustion chamber and radiator. Casing is of 20-gauge steel.
SIZES AND CAPACITIES—85,000 and 120,000 Btu input per hour.
MADE BY — *Norman Products Co., 1150 Chesapeake Ave., Columbus 8, Ohio.* **348**

Motor Operated Valve

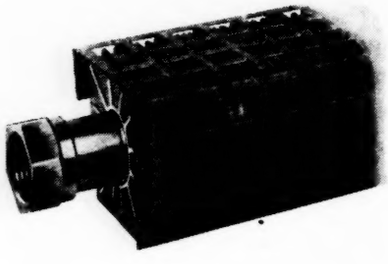
NAME—Barcol motor-operated valve.
PURPOSE—Valve operation.
FEATURES—Operators are powered by a Barcol shaded pole induction motion through a reduction of machine-cut gears. All steel gears



are heat treated. Cam operated switches stop the operator at the end of its stroke. Unit has been designed for both high and low voltage applications.
MADE BY—*Barber-Colman Company, Rockford, Ill.* **349**

Extended Surface Radiation

NAME—Webster type WI extended surface radiation.
PURPOSE—Space heating.
FEATURES—Unit is made of copper tubing, 1⅛ in. outside diameter with rib-reinforced square pressed aluminum fans and brass female



couplings. Standardization is obtained through the use of only one tube diameter and one fin size. A perforated pressed steel cover is provided for use where desired. Covers enclose front and top and provide a 1 in. overhang in the back. Covers are handpressed in position and can be removed without tools.
SIZES AND CAPACITIES—Five lengths from 2 to 6 ft inclusive.
LITERATURE AVAILABLE — Bulletin B 1550A.
MADE BY—*Warren Webster & Co., Camden, N. J.* **350**

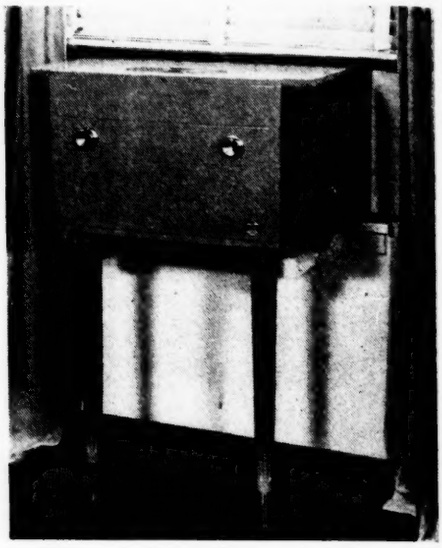
Vibration Control

NAME—Vibro-insulators.
PURPOSE—Vibration isolation.
FEATURES — The rubber is of 45 durometer hardness. Type 130 carries a maximum recommended load

of 132 lb with a maximum deflection at that load of 3/16 in. For type 133, the maximum load is 180 lb and the deflection at that load is 5/32 in.
MADE BY—*The B. F. Goodrich Co., Akron, Ohio.* **351**

Room Air Conditioner

NAME—Chrysler Airtemp room air conditioner.
PURPOSE—Space cooling for individual rooms.
FEATURES—Unit is powered by a ¾ hp motor and equipped with an adjustable outside air intake. Fans may be operated separately for ventilation and air circulation when cooling is not required. Supply air grilles are designed to give a wide adjustment of air distribution. Unit is provided with the Chrysler sealed radial compressor. Cooler comes complete in a compact cabinet and



only requires connection to an electric outlet.
MADE BY—*Airtemp Div., Chrysler Corp., Dayton 1, Ohio.* **352**

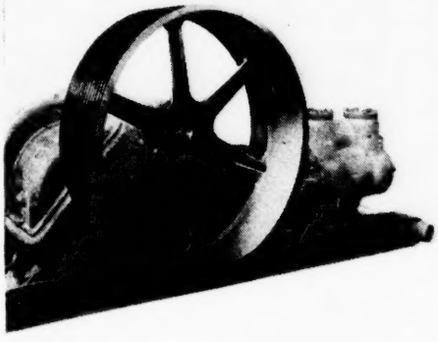
Gas Valve Set

NAME—A-P gas valve set.
PURPOSE—Control of gas burning.
FEATURES — Set includes valve, transformer, wiring, accessories and a thermostat. Valve is of gas solenoid type for use in combination

with a thermostat and transformer on gas-fired furnaces. Valve has a separator which divorces the solenoid parts from the flow of gas. Valve is available with ¾ in. tap.
MADE BY—*Automatic Products Co., Milwaukee, Wis.* **353**

Sheaves

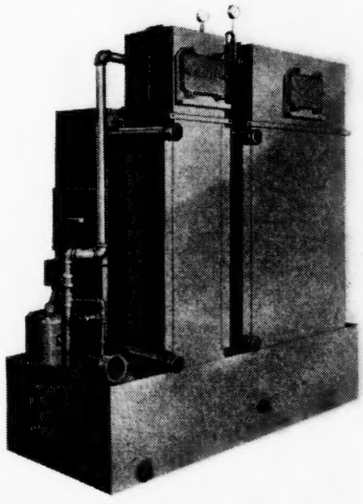
NAME—Worthington QD sheaves.
PURPOSE—For power transmission through improved groove-belt sheaves.
FEATURES — Reinforced arm construction incorporates a longitudinally ribbed air recessed down the middle. Advantage claimed for this type arm is that material is removed at or near the neutral axis which adds little or no strength to the arm. This material is then added at points most remote from the neutral axis where it gives added strength.
SIZES AND CAPACITIES—Two types,



designated as A and B designed to match A & B belts.
MADE BY—*Worthington Pump and Machinery Corp., Harrison, New Jersey.* **354**

Humidity Control

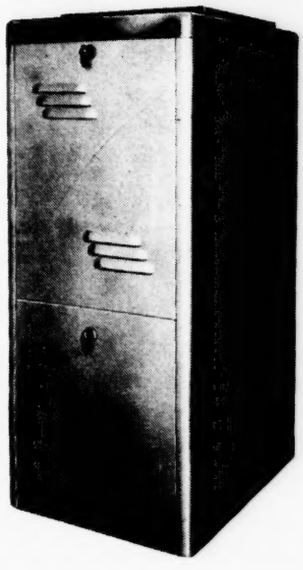
NAME—Kathabar.
PURPOSE—Humidity control for small demands.
FEATURES—Self-contained system utilizes a chemical absorption medium for controlling the moisture content of the air. Capacity and rate of absorption are determined by its temperature. Absorption medium is said to be free from deterioration, can be used continuously and is non-corrosive.
OPERATION—Operation consists of bringing outside air in contact with a chemical solution by the use of a contactor cell. The air makes thorough contact with this solution and the moisture is removed. Solution temperature is maintained by regulating water supply to the contactor cooler. Operation is automatic. A small percentage of solution is regenerated to return all the solution to normal strength. Solution is filtered during the regeneration process.



SIZES AND CAPACITIES—Units available for 1350, 2500, 3500 and 5000 cfm.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*Surface Combustion Corp., Toledo 1, Ohio.* **355**

Warm Air Furnace

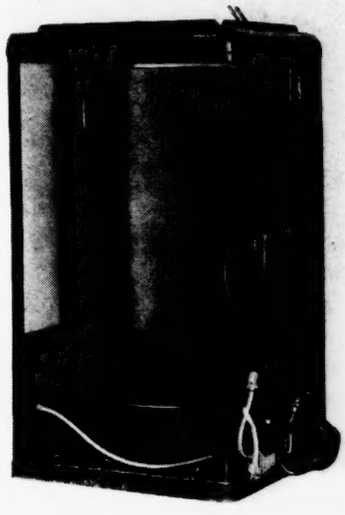
NAME—Norman winter air conditioner.



PURPOSE—Warm air automatic gas heating.
FEATURES—Lower front door permits easy accessibility to blower, motor and filter. A 1/6 hp motor is provided with adjustable pulley. One burner handles natural, mixed, and manufactured gas. Heating element is specifically designed to prevent hot spots.
SIZES AND CAPACITIES — 60,000, 90,000 and 125,000 Btu input per hour.
MADE BY — *Norman Products Co., 1150 Chesapeake Ave., Columbus 8, Ohio*.....**356**

Oil-Burning Furnace

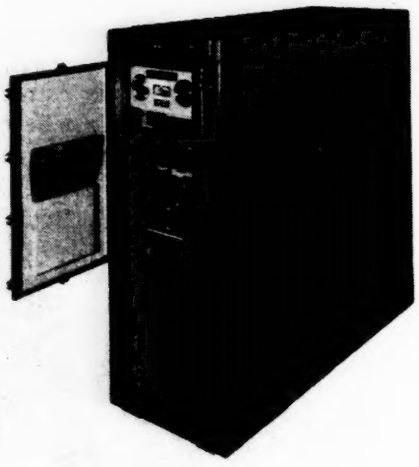
NAME—Quick heat oil burning furnace.
PURPOSE — Space heating for the home.
FEATURES — Pressure fans can be mounted on back or either side of furnace by removing plate from desired precut opening. Fan switch is mounted on front of furnace. Burner



is of two-stage vaporizing type. Automatic fuel control valve meters flow of oil to furnace. Safety trip shuts off oil in case of flame failure. Standard equipment includes automatic fuel control valve, mechanical forced draft blower, thermostat, combination fan and limit control and humidifier. Pressure fan or blower is extra equipment.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY — *American Stove Company, 1200 Long Avenue, Lorain, Ohio*.....**357**

Humidity Control

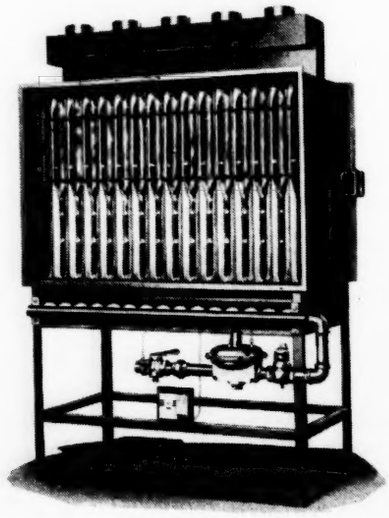
NAME—DryNamic.
PURPOSE—Dehumidification of air.
FEATURES — Filtered air passes through a desiccant cylinder where its entrained moisture is removed and the dehumidified air is discharged to the treated space. Simultaneously the other desiccant cylinder is having its entrapped moisture removed by a flow of heated air. Changeover from one cylinder to the other insures a continuous supply of dried air by a completely automatic valve and control system. When there is no immediate need for dehumidification the unit shuts down.



SIZES AND CAPACITIES—In various models for air flow of 20 to 13740 cfm and a removal of 0.5 to 200 lb of water per hour.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*Cargocaire Engineering Corp., 15 Park Row, New York 7, N. Y.* **359**

Hayes Duct Furnace

NAME—Hayes SED duct furnace.
PURPOSE—To be installed into and become a section of a duct system.
FEATURES—Gas-fired duct furnace, conceived to simulate, in installation, steam and hot water coils but not intended to supplant such coils. Its aim is to augment these systems by increasing the volume of commercial air systems with lower initial costs. Heat exchanger is constructed of type 321 stainless steel, which is not affected by condensation and which will withstand exceptionally high temperatures. Unit requires comparatively small floor space in ratio to capacity. May be installed in banks for large capacity. All joints welded. Non-



corrosive properties of the steel permit the installation of the unit downstream of cooling coils. Unit comes complete with wind tunnel or casing controls; latter as required by AGA.
SIZES AND CAPACITIES — Size 600 SED has 600,000 Btu per hour capacity and requires a space 50 x 28 in. in plan. Hangars may be provided for suspension.
MADE BY—*Hayes Furnace & Manufacturing Co., Inc., 2929 S. Fairfax Ave., Los Angeles 16, Calif.*.....**360**

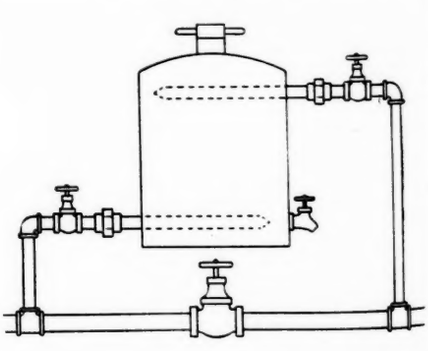
Dehydrator

NAME—Electrimatic.
PURPOSE — Dehydration of air in pipe lines.
FEATURES—An especially designed diffusing spiral is used in connection with a tubular inlet screen. Screen provides increased area at the point where dirt is most likely to accumulate, while the spiral promotes uniform diffusion of gas into the silica gel. Outlet filter is of porous bronze metal which acts as a final trap for any fine particles of dirt or silica gel. Brass end fittings are silver soldered to brass end caps, and end caps are soft soldered to the brass tube by means

of a specially developed process. Inlet screen is easily removable for cleaning, and refilling dryer with silica gel when required. A gasket provides a positive seal at the inlet screen fitting. Dryers are sealed with brass flare nuts and copper seal caps to prevent "breathing" of moisture during storage.
MADE BY—*Electrimatic, 2100 Indiana Ave., Chicago 16, Ill.*.....**361**

Chemical Feeder

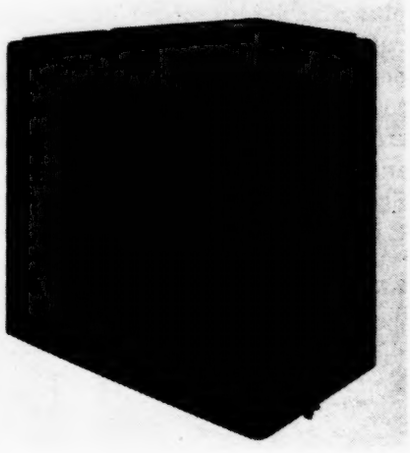
NAME—Micromet feeder.
PURPOSE—Appliance to add Micromet to water lines to correct corrosion and scale water troubles.
FEATURES — Since only 25% of chemical dissolves per month, only small amount has to be added monthly to make up for that dissolved. While small models will handle as little as 3,000 gal per month, larger feeders are for 1 mg



per month. For hard waters producing lime scale, feeder will handle up to 300,000 gal.
SIZES AND CAPACITIES — Feeders holding 20, 50, or 100 pounds of Micromet.
MADE BY—*Calgon, Inc., 323 Fourth Ave., Pittsburgh 30, Pa.*.....**362**

Furnace

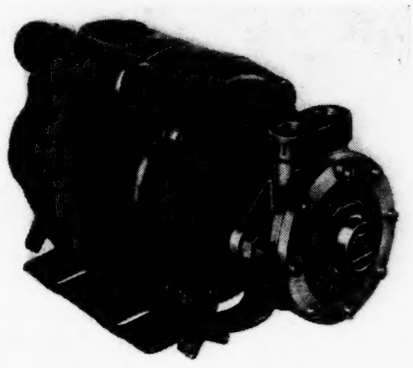
NAME—Duo-Therm.
PURPOSE—Space heating for the home.
FEATURES—Burner has flame control which operates from a low to a high fire. Burner has no moving parts and is built of heavy gauge steel. A heavy duty blower is insulated against noise and vibration. Comfort selector switch, part of the room thermostat, permits changing to little heat on mild days at which time the low fire setting



on the burner is automatically reduced. A flip of the switch the other way steps up the low fire setting for a steady flow of heat. Once the comfort selector is set, room temperature is controlled by the thermostat.
LITERATURE AVAILABLE—Illustrated catalog.
MADE BY—*Duo-Therm, Division of Motor Wheel Corp., Lansing 3, Mich*.....**363**

Pump

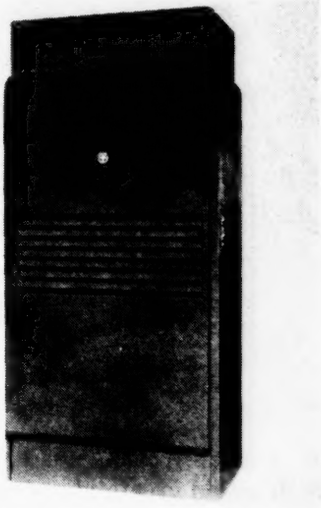
NAME—Candler-Hill pump.
PURPOSE—For handling fluids in the medium flow and pressure fields.
FEATURES — Rotating impeller is designed to hydraulically float in the housing and there is no metal-to-metal contact between rotating and stationary parts. Unit has the ability to flow liquid directly through the pump when it is not operating. Pumping mechanism's components are fabricated from



corrosion resistant materials to suit the type of material being handled.
SIZES AND CAPACITIES—In general applications where 100 lb per sq in. discharge pressure is required, flow is from 50 to 60 gph. Other pressure and volume requirements can be made available.
MADE BY — *Candler-Hill Corporation, Division of Titan Pump and Engineering Corporation, Detroit, Mich*.....**364**

Air Conditioner

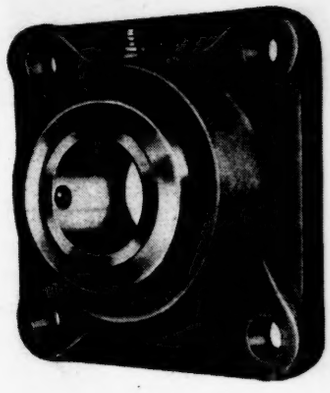
NAME—Typhoon Prop-R-Temp.
PURPOSE—Self-contained air conditioning unit for small and medium sized stores and offices.
FEATURES—Compressor is designed to deliver full capacity at moderate



speed. Entire compressor assembly is isolated on helical steel springs. Filters are of the throw away type. A large forward curve blade fan delivers air at low speed for quiet operation.
SIZES AND CAPACITIES—3, 5, and 7-ton refrigeration.
LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*Ice Air Conditioning Co., Inc., 794-6 Union St., Brooklyn 15, N. Y.* **365**

Ball Bearing Flange

NAME—Type SC ball bearing flange.
PURPOSE—Mounting or support for shafts.
FEATURES — Bearing is self-aligning and has deep groove precision



ball bearings with a long inner race. Makers claim it is suitable for mounting against vertical or horizontal frames and supports.
MADE BY — *Dodge Manufacturing Co., Mishawaka, Ind.* **366**

Protective Coating

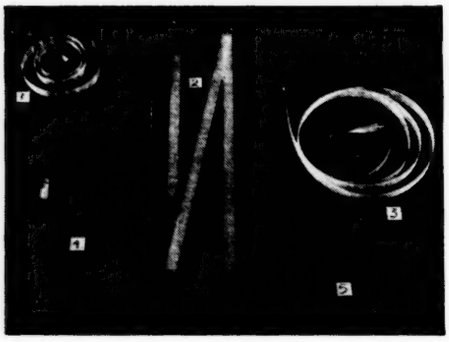
NAME—Zincilate.
PURPOSE — Protective coating for ferrous metals.
FEATURES—Coating is said to be unaffected after 1000 hours exposure in standard salt-fog corrosion equipment as approved by the American Society of Testing Materials. Zincilate is a one-coat protective coating which is said to have good abrasion resistance.
MADE BY — *Industrial Metal Protectives Corp. of Virginia, Newport News, Va.* **367**

Plastic Gauges

NAME—Plastic gauges for fuel oil tanks.

PURPOSE — For measuring the oil level in oil tanks.

FEATURES — Plastic gauges have frosted surfaces with number etched in the plastic to denote number of gallons in the tank. Frosted plastic appears clear when wet. In the illustration are: 1. Gauge for 550 gal outdoor tank. 2. 6 ft folding

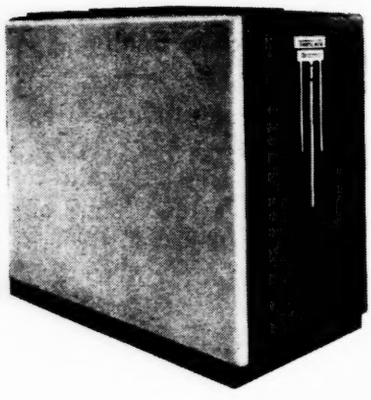


gauge. 3. Gauge for small bulk tanks. 4. Rule which fits over a regular steel gauge tape for large bulk measurements. 5. Gauge for 55 gal drums. Pastacele is used for 1 and 3, and Lucite for the other gauges.

MADE BY — *B and K Plastics Co., Paterson, N. J., for Sweet Practical Products Company, Hackensack, N. J.* 368

Furnace

NAME—Thatcher V-series Comfortmaster.



PURPOSE—Space heating for the home.

FEATURES—Flue passages are designed to provide a symmetrical flow of flue gases. Blower draws air through the return ducts and passes it over the preheater, through the filters, and then blows it over the heating surfaces of the furnace proper. Unit has large removable filters of the throwaway type, and a Thatcher vaporizing humidifier. A turn of one handle removes the front panel of the cabinet and thus enables easy access to the oil burner, controls and humidifier.

SIZES AND CAPACITIES — V-116, 90,000 Btu at register; V-120, 140,000 Btu at register.

LITERATURE AVAILABLE—Illustrated folder.

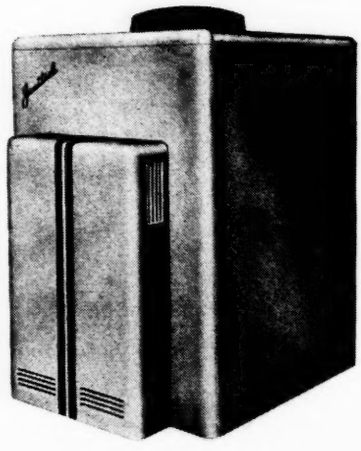
MADE BY—*Thatcher Furnace Co., Garwood, N. J.* 369

Gas Furnace

NAME — Janitrol series GCS - 64 gravity furnace.

PURPOSE—Space heating.

FEATURES — Combustion chamber and radiator assembly is made of all welded 18-gage steel with all of the larger joints seam welded. Makers claim that the entire heat-



ing assembly has no hot spots which would create stresses in construction. Standard equipment includes a flame retention type burner with a special alloy flame diffuser and a Venturi mixer for the proper mixture of oil and gas; a fixed orifice centered in relation to the Venturi mixer input; and a burner air duct which directs secondary air to the burners.

SIZES AND CAPACITIES—Two sizes available—75,000 and 100,000 Btu.

MADE BY—*Surface Combustion Corp., Toledo 1, Ohio.* 370

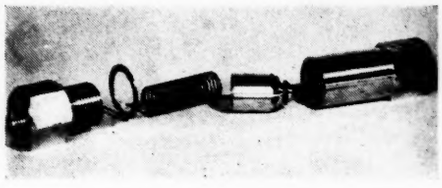
Check Valve

NAME—Mansfield & Green check valve.

PURPOSE—Control for fluid flow.

FEATURES—Double seal developed which utilizes a metal to metal seat plus a resilient rubber or synthetic rubber seal on the check valve poppet. Line pressure forces the ring to the metal seat and this force increases with an increase of pressure.

SIZES AND CAPACITIES—From ⅛ to 1 in. for pressures to 10,000 lb per



sq in. and for any media not destructive to rubber or synthetic rubber.

MADE BY—*Mansfield & Green, Cleveland, Ohio.* 371

Turbine Unit Heater

NAME — Wing turbine revolving unit heaters.

PURPOSE—Space heating.

FEATURES—Unit uses a fan driven by a steam turbine. Turbine exhaust passes into the heater section where it is used to heat the air which the turbine-driven fan then delivers through the revolving discharge outlets to the working level below. Condensate, which is said to be never at a higher temperature than 170F, is returned to the boiler through an open return system.

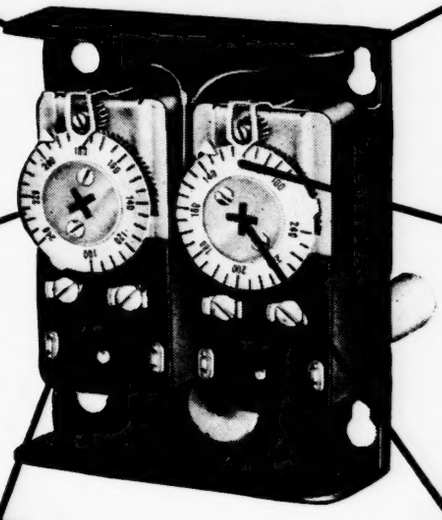
LITERATURE AVAILABLE—Illustrated folder.

MADE BY—*L. J. Wing Mfg. Co., 154 West 14th St., New York 11, N. Y.* 372

Look for these features in a Hot Water Control!

TWO INDIVIDUAL CONTROLS — SINGLE HOUSING — SINGLE 3/4" TAPPING

MOUNT AT ANY ANGLE OR POSITION



ACCURATE AT ANY TEMPERATURE IN DIAL RANGE

DIFFERENTIAL CONSTANT THROUGHOUT RANGE

DIALS ACCURATELY CALIBRATED IN DEGREES FAHRENHEIT

SETTINGS EASILY AND QUICKLY MADE WITH SCREWDRIVER

WHITE-RODGERS Hydraulic-Action Limit and Circulator Controls offer you all these advantages and more! Accepted as standard by leading manufacturers of heating and air-conditioning equipment, they offer you benefits you can't afford to overlook. Investigate the complete line of White-Rodgers Heating Controls.

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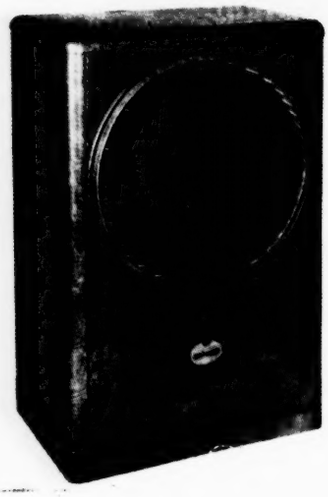
Controls for Refrigeration • Heating • Air Conditioning

Gas Heater

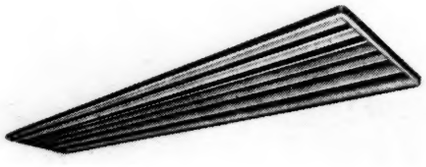
NAME — Coroaire—Console model 85G.
PURPOSE—Space heating.
FEATURES—An adjustable air shutter regulates the primary air. Venturi type passages are used in the combustion chamber and heat exchanger. Fan, 18 in. in diameter,



is of the slow speed type. Air circulated by fan, passes through a filter. Summer switch permits operating the fan without the heater. As soon as heat exchanger is up to 150F, fan switch closes the circuit and causes fan to operate. Magnetic valve controls the gas supply.
SIZES AND CAPACITY—85,000 Btu per hr.
MADE BY—*The Coroaire Heater Corp., Cleveland 15, Ohio.* **373**

Air Distribution

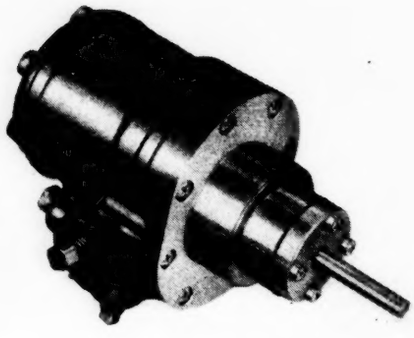
NAME—Line-O-Flo.
PURPOSE—Air distribution from ceiling outlet.
FEATURES—Unit has a balancing arrangement so that air stream is distributed uniformly over the en-



tire area of the outlet. Each side plate and divider plate forms a bell mouth approach to a converging nozzle which discharges the air by its Venturi action to create velocity from static pressure to carry the air stream over its length of throw. Unit is said to have rapid diffusion of the supply air within the zone being conditioned. Fabrication is such that it can be assembled into continuous units or used as individual panels.
MADE BY—*Barber-Colman Company, Rockford, Ill.* **374**

Fuel Oil Pipe

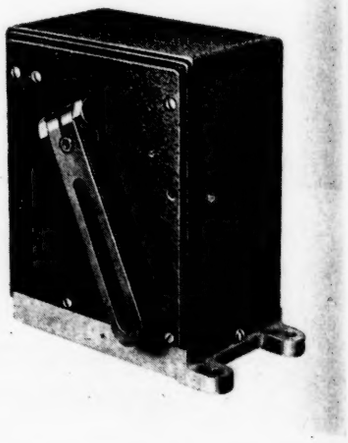
NAME—Polo type 12 oil burner fuel pump.
PURPOSE—Pump for fuel oil burners.
FEATURES — Strainer consists of four nested cylinders of fine mesh monel screen, providing large strainer area in a compact re-



movable cartridge. Shaft is hard chrome plated. Gear pump members are of special design for smooth operation. Entire unit can be taken apart with ease.
SIZES AND CAPACITIES — At 1725 rpm, 100 lb per sq in pressure, pump delivers 12 gph.
MADE BY — *Polo Pump Company, Polo, Illinois.* **375**

Control Motor

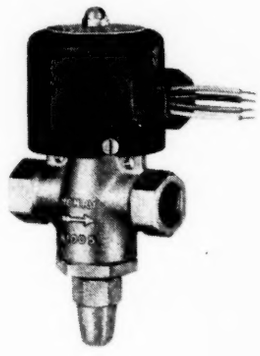
NAME — Barcol air cooled control motor.
PURPOSE—For operation of dampers.
FEATURES—Barcol shaded pole induction motor drives the main shaft through machine cut reduction



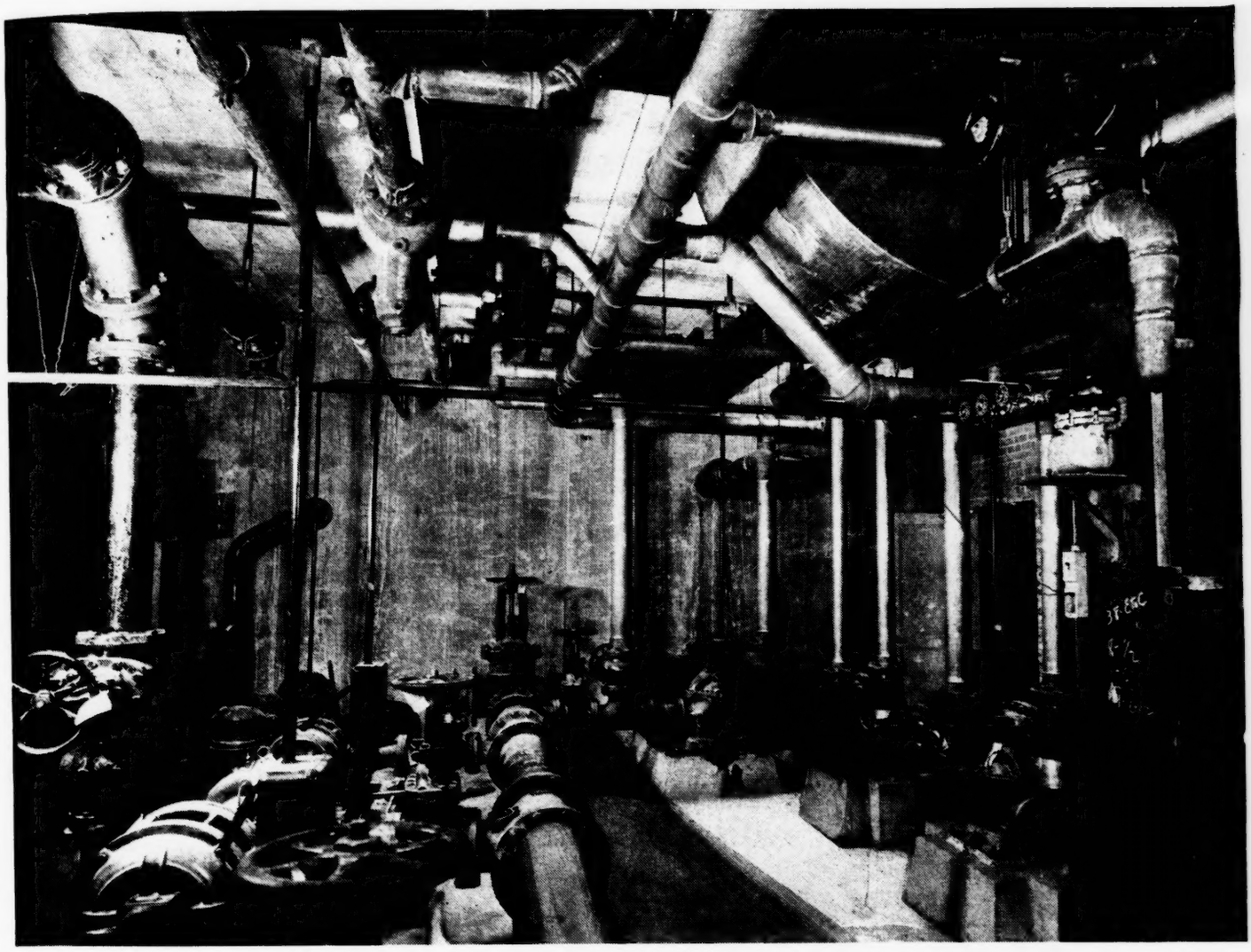
gears. Cam operated limit switches stop the motor at the end of the stroke. The entire mechanism is protected by a metal cover.
MADE BY — *Barber-Colman Co., Rockford, Ill.* **376**

Solenoid Valve

NAME—Henry Type SV51 solenoid valve.
PURPOSE—For the control of pipe lines containing Freon.
FEATURES — Two piece impact plunger operates pilot port in piston. Molded synthetic ring provides soft seat at main port for piston. Unit has manually operated stem for emergency use. While the main body is of bronze casting, internal



parts are of stainless steel. All internal parts may be removed from the bottom of the valve.
SIZES AND CAPACITIES — Normal capacity, five tons liquid Freon.
MADE BY—*Henry Valve Co., 3260 West Grand Avenue, Chicago 51, Ill.* **377**



Insure Unrestricted Flow with REVERE COPPER WATER TUBE

FRICTION caused by rust accumulations inside the lines can materially lower the efficiency of forced circulation heating systems. Such installations derive full benefit from the permanently smooth interior of Revere Copper Water Tube. This tube is 99.9% pure copper, seamless and cold-drawn with a gun-barrel finish inside. Since it will not rust, it permits full and unrestricted flow of water throughout years of continuous service.

In any heating, water-supply or air-conditioning installation—for a large industrial plant or a small home—*trouble always costs more than Revere Copper Water Tube.* This tube is ideal for these and other piping services in all types and sizes of buildings. Joints are easily made with either soldered or compression fittings . . . and even the hard temper Type K tube, in sizes up to 1" inclusive, is easy to bend by means of a hand-operated tool.

Revere Copper Water Tube is stamped at regular intervals with the Revere name and the type. Look for these identification marks—they insure full wall thickness and the close gauge tolerances so essential for tight sweated joints.

You can specify or install, in addition to Revere Copper Water Tube, such other long-lived Revere materials as Red-Brass Pipe; Sheet Copper for tanks, ducts, pans and trays; Dryseal Copper Refrigeration Tube (dehydrated and sealed); Copper oil burner, heat control and capillary tubes.

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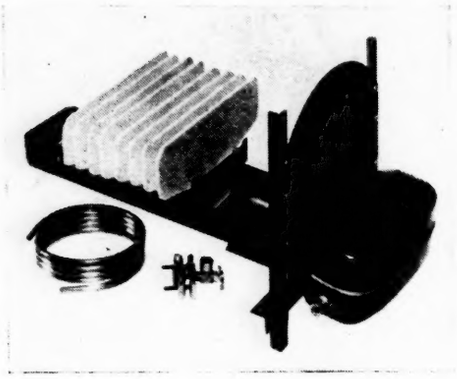
230 Park Avenue, New York 17, New York

Mills: Baltimore, Md.; Chicago, Ill.; Detroit, Mich.; New Bedford, Mass.; Rome, N. Y.—Sales Offices in Principal Cities, Distributors Everywhere.

Humidifier

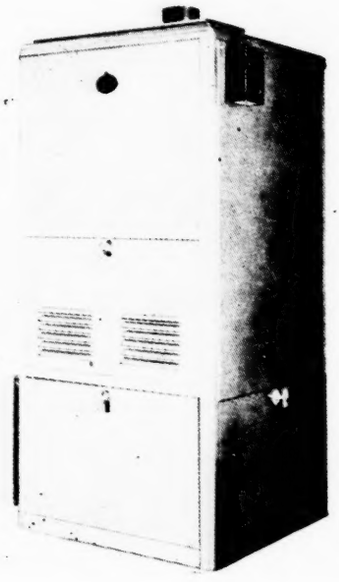
NAME—Viking No. 1300 humidifier.
PURPOSE—For installation in warm air furnaces to humidify the air.
FEATURES—Unit is of all copper construction. Mounting frame has an access panel as an integral part. The entire humidifier is mounted on the front of the plenum as a unit. An accessible screw accurately lev-



els the pan. Available in 16- and 20-in. pan sizes.
MADE BY—*Viking Air Conditioning Corp., 5600 Walworth Ave., Cleveland 2, Ohio.* **378**

Forced Air Furnace

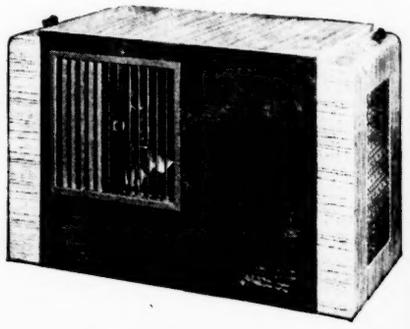
NAME—Coroaire Hi-Boy.
PURPOSE—Space heating.
FEATURES—Unit has a 10-in. blower wheel with an adjustable pulley for producing from 600-1260 cfm at 600-800 rpm. A 1/6-hp motor is connected by a V-belt drive. Motor has thermal overlead protection.



LITERATURE AVAILABLE—Illustrated folder.
MADE BY—*The Coroaire Heater Corp., Cleveland 15, Ohio.* **379**

Room Cooler

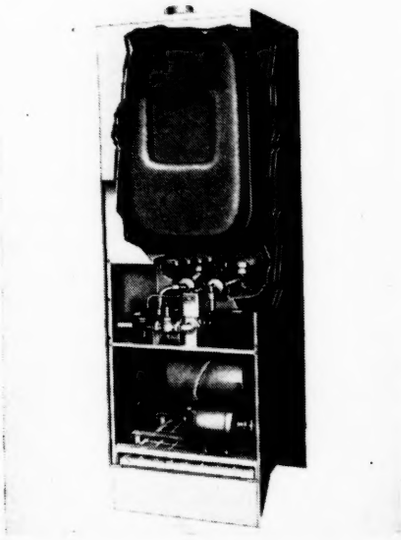
NAME—Kauffman portable room cooler.
PURPOSE—Space cooling.
FEATURES—Air is distributed at angle of 25° to give even distribution. All moving parts are mounted on rubber vibration dampers to



eliminate noise. Unit has a heavy copper reservoir pan for collection of surplus condensation.
SIZES AND CAPACITIES—Units for cooling rooms of 2500, 4000, 6000, and 9000 cubic feet with ordinary exposures.
MADE BY—*Kauffman Air Conditioning Corp., St. Louis, Mo.*.....**380**

Gas Furnace

NAME—Superfex Hi-Boy gas furnace.
PURPOSE—Space heating by warm air.
FEATURES—Rated input of furnace is 60,000 to 75,000 Btu. All parts are accessible and are easily removed from the front. All controls



normally on the furnace are concealed. Unit has a 3-stage burner and a 2-speed blower. Furnace can be installed in the basement for a conventional installation, or it may be installed in a closet.
MADE BY—*Perfection Stove Co., Cleveland, Ohio.* **381**

March, 1947

TO OBTAIN FURTHER INFORMATION ON NEW EQUIPMENT

On the list below, circle the item number of the equipment in which you are interested, using the number found at the end of each item.

345	346	347	348	349	350	351	352	353	354
355	356	357	358	359	360	361	362	363	364
365	366	367	368	369	370	371	372	373	374
375	376	377	378	379	380	381			

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Editor, HEATING AND VENTILATING, 148 Lafayette St., New York 13, N. Y.

Name.....

Title (Must be shown).....

Firm (Must be shown).....

(For prompt service, title and firm name must be shown above.)

Business Address.....

City.....**Zone**.....**State**..... 3/47

The Refrigeration Equipment Manufacturers Association estimates that air conditioning can be included in new apartment building projects at a cost to the tenant of $1.27 per month per room.

Based on air conditioning requirements in a temperate climate this estimate covers the cost of equipment, installation, operation plus a return on the investment.

With air conditioning in reach of the average-income tenant REMA predicts that apartment buildings without this convenience will become obsolete in 10 years.

This indicates a steadily increasing demand for air conditioning equipment and high quality ductwork. The proper installation of long lasting ductwork will depend largely on easy working rust-resisting steel sheets. Beth-Cu-Loy Galvanized Sheets have the qualities that sheet metal contractors know are important for air conditioning jobs. They are highly ductile, simple to form, cut and solder. They have a copper-bearing base with a uniform zinc coating that combine to give double rust-protection. With Beth-Cu-Loy Galvanized Sheets ductwork can be expected to last considerably longer than that made from ordinary steel sheets.

Bethlehem Steel Company, Bethlehem, Pa.

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BETH-CU-LOY GALVANIZED SHEETS

Degree-Days for January, 1947

HEATING AND VENTILATING's 20th Year of Publication of Monthly Degree-Day Data

City	January			Cumulative, Sept. 1, 1946 to Jan. 31, 1947			Heating Season[1]
	1947	1946	Normal	1946-47	1945-46	Normal	Normal
Abilene, Texas	727	698	326	1557	1761	1251	2061
Albany, New York	1213	1265	1287	3453	3991	3726	6580
Albuquerque, New Mexico	991	979	924	2743	2812	2751	4298
Alpena, Michigan	1296	1337	1431	3964	4296	4382	8299*
Anaconda, Montana	1381	1198	1321	4915	4394	4492	8357**
Asheville, North Carolina	669	794	831	1994	2605	2520	4232
Atlanta, Georgia	592	657	682	1404	1980	1813	2890
Atlantic City, New Jersey	734	916	992	2010	2610	2727	5176
Augusta, Georgia	420	489	555	1050	1535	1441	2161
Baker, Oregon	1348	1211	1218	4286	4026	4033	7163
Baltimore, Maryland	728	856	955	1951	2525	2619	4533
Billings, Montana	1195	1063	1318	4202	3955	4134	7119
Binghamton, New York	1045	1157	1268	3073	3708	3783	6808
Birmingham, Alabama	526	618	589	1356	1897	1502	2352
Bismarck, North Dakota	1449	1651	1807	5082	5524	5321	9192
Block Island, Rhode Island	897	1001	1048	2424	2937	2784	5788
Boise, Idaho	1294	1114	1097	3788	3466	3382	5552
Boston, Massachusetts	1001	1133	1150	2747	3289	3280	6045
Bozeman, Montana	1351	1302	1403	4642	4555	4689	8521**
Buffalo, New York	1087	1166	1240	3119	3765	3612	6822
Burlington, Vermont	1367	1422	1429	3857	4397	4202	7514
Butte, Montana	1475	1304	1309	5182	4783	4492	8272
Cairo, Illinois	758	819	908	1897	2479	2407	3909
Canton, New York	1418	1463	1520	4052	4590	4514	8020
Charles City, Iowa	1272	1449	1560	3860	4643	4455	7588
Charleston, South Carolina	281	440	487	716	1256	1119	1769
Charlotte, North Carolina	564	670	725	1476	2001	1945	3120
Chattanooga, Tennessee	652	719	732	1742	2235	1957	3118
Cheyenne, Wyoming	1184	1148	1215	4031	4023	4104	7466
Chicago, Illinois	1052	1137	1190	2922	3566	3362	6077
Cincinnati, Ohio	787	910	1017	2155	2935	2813	4684
Cleveland, Ohio	998	1109	1181	2812	3389	3366	6155
Columbia, Missouri	948	998	1110	2488	3134	3006	4922
Columbia, South Carolina	431	537	586	1075	1623	1502	2364
Columbus, Ohio	904	1016	1113	2523	3209	3133	5398
Concord, New Hampshire	1339	1420	1349	3889	4343	4081	7353
Concordia, Kansas	1048	995	1184	2987	3272	3203	5315
Dallas, Texas	598	605	617	1315	1572	1487	2256
Davenport, Iowa	1129	1202	1352	3095	3860	3685	6289
Dayton, Ohio	972	1104	1116	2743	3510	3063	5264
Denver, Colorado	983	954	1079	3202	3215	3355	5874
Des Moines, Iowa	1158	1262	1392	3301	3920	3762	6384
Detroit, Michigan	1105	1141	1252	3069	3632	3584	6490
Devils Lake, North Dakota	1597	1825	1494	5587	6164	5820	9970
Dodge City, Kansas	1022	953	1116	2900	3009	3068	5035
Dubuque, Iowa	1217	1292	1442	3434	4145	3976	6790
Duluth, Minnesota	1547	1658	1727	5110	5445	5216	9483
Eastport, Maine	1316	1367	1380	3876	4223	4270	8520**
Elkins, West Virginia	846	984	1048	2796	3384	3265	5697
El Paso, Texas	773	742	629	1824	1771	1667	2428
Ely, Nevada	1397	1363	(a)	4589	4432	(a)	(a)
Erie, Pennsylvania	1000	1066	1172	2714	3322	3336	6273
Escanaba, Michigan	1389	1421	1550	4326	4616	4688	8771*
Evansville, Indiana	836	960	949	2307	2944	2494	4244
Fort Smith, Arkansas	(a)	780	850	(a)	2201	2027	3147
Fort Wayne, Indiana	1100	1197	1194	3114	3818	3405	5925
Fort Worth, Texas	614	621	580	1339	1585	1406	2148
Fresno, California	745	640	583	1917	1565	1494	2334
Galveston, Texas	403	360	353	725	754	683	1016
Grand Junction, Colorado	1327	1203	1233	3689	3590	3511	5548
Grand Rapids, Michigan	1142	1175	1262	3157	3757	3659	6535
Green Bay, Wisconsin	1356	1434	1538	4079	4600	4420	7825
Greensboro, North Carolina	649	787	772	1864	2470	2167	3529
Greenville, South Carolina	589	690	744	1517	2118	2078	3380
Harrisburg, Pennsylvania	901	1011	1088	2590	3143	3069	5375
Hartford, Connecticut	1063	1196	1159	2993	3653	3316	6036
Hatteras, North Carolina	337	552	589	828	1449	1316	2571
Havre, Montana	1319	1216	1624	4994	4739	4938	8700
Helena, Montana	1398	1134	1375	4856	4350	4433	7898
Houston, Texas	414	401	366	768	905	815	1157
Huron, South Dakota	1294	1533	1650	4405	4905	4735	8004
Indianapolis, Indiana	926	1050	1128	2500	3270	3130	5298
Jackson, Miss.	506	539	(a)	1116	1517	(a)	(a)
Kansas City, Missouri	987	995	1141	2545	3092	3007	4956
Kewanee, Illinois	1124	1197	1223	3111	3653	3534	6139
Knoxville, Tennessee	658	768	815	1822	2353	2298	3670
La Crosse, Wisconsin	1358	1436	1535	4102	4721	4313	7322
Lander, Wyoming	1412	1269	1436	4602	4638	4511	7947

[1]Figures in this column are normal totals for a complete heating season, September to June, incl.

Figures in this table, with nine exceptions, based on local weather bureau reports. Exceptions are Utica, Lewiston, Kewanee, Sioux City, and Jackson, figures for which are furnished through the courtesy of Coke Sales Department, Central New York Power Corp., Utica, N. Y.; Norman E. Ross, Bursar, Bates College, Lewiston, Me.; J. M. Hartman, Engineering Department, Kewanee Boiler Corp., Kewanee, Ill.; Alfred R. Wagstaff, Engineer, Sioux City Foundry and Boiler Co., Sioux City, Iowa, and H. M. Ludlow, Box 1368, Jackson, Miss., respectively; Anaconda, Bozeman, Butte and Livingston, Mont., through the courtesy of the Montana Power Company.

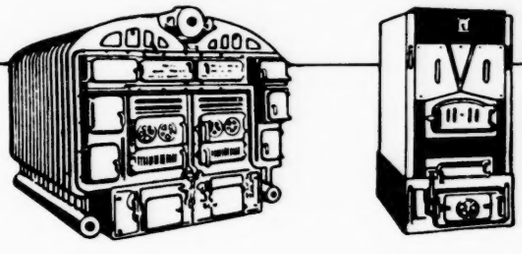
[Table concluded on Page 100]

"This boiler can wait 'til the roof is on"

When your client's heating plant is to be H. B. Smith, you can go right ahead and finish your building *before* you install the boiler. This means that when material and labor shortages slow down or stop the job, your new boilers don't have to stand in a half-erected building exposed to the elements.

H. B. Smith boilers can be placed in *any* building, through ordinary doorways, because they are assembled from multiple cast-iron sections. These *sections* are shipped directly to the point of installation, where they are assembled quickly and easily. H. B. Smith header-type construction cuts erection time and costs too.

Once an H. B. Smith *Cast-Iron* Boiler is installed, the owner usually agrees that there is no finer looking, finer performing boiler in service. So when your building schedule calls for a boiler that can be installed "after the roof is on" . . . or whenever there is need for uninterrupted, efficient low-cost heating . . . recommend H. B. Smith Boilers, for new installations or replacement. For the complete story of H. B. Smith dependability, write for your free catalog.



H.B. Smith

CAST-IRON BOILERS

THE H. B. SMITH CO., INC., WESTFIELD, MASS. Offices and Representatives in Principal Cities

Degree-Days for January, 1947 (Concluded)

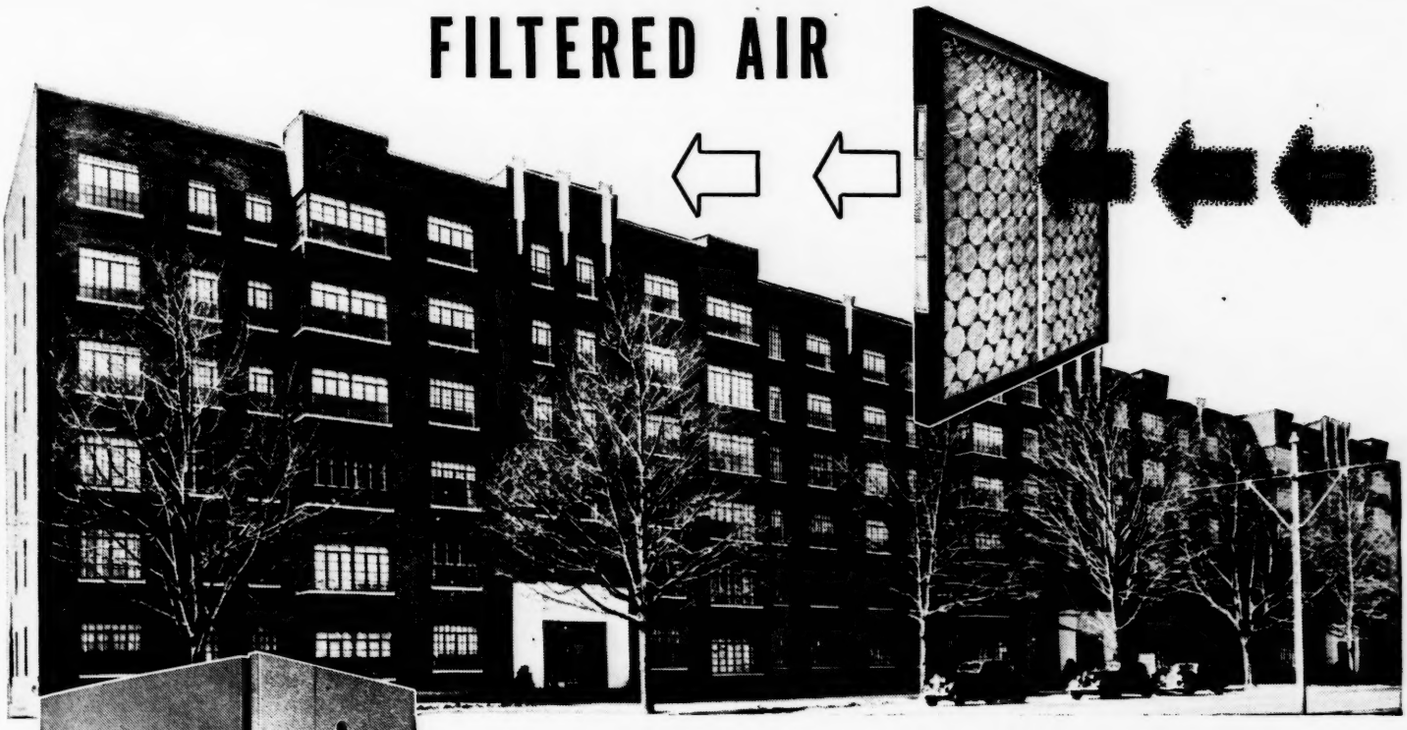
HEATING AND VENTILATING's 20th Year of Publication of Monthly Degree-Day Data

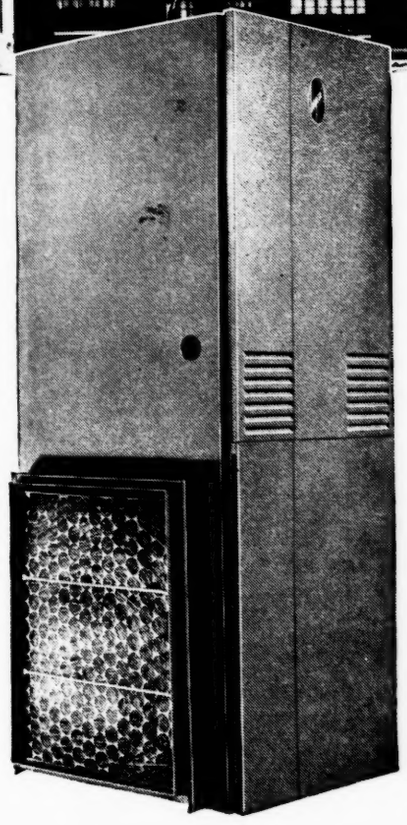
City	January			Cumulative, Sept. 1, 1946 to Jan. 31, 1947			Heating Season[1]
	1947	1946	Normal	1946-47	1945-46	Normal	Normal
Lansing, Michigan	1189	1230	1336	3391	4016	4001	7048
Lewiston, Maine	1427	1483	1452	4090	4524	4289	7707
Lincoln, Nebraska	1087	1113	1311	3153	3541	3512	5999
Little Rock, Arkansas	658	726	719	1603	2079	1798	2811
Livingston, Montana	1257	1091	1220	4373	3990	3951	7205
Los Angeles, California	285	224	326	816	637	750	1504
Louisville, Kentucky	780	899	939	2075	2693	2526	4180
Lynchburg, Virginia	720	863	856	2026	2644	2413	3980
Macon, Georgia	448	493	549	1141	1579	1446	2201
Madison, Wisconsin	1299	1359	1500	3727	4396	4258	7429
Marquette, Michigan	1366	1408	1500	4291	4603	4554	8693*
Memphis, Tennessee	664	744	744	1590	2164	1871	2950
Meridian, Mississippi	477	539	552	1172	1534	1435	2160
Milwaukee, Wisconsin	1220	1307	1383	3615	4059	3984	7245
Minneapolis, Minnesota	1348	1544	1609	4314	4876	4550	7850
Modena, Utah	1260	1133	1187	3920	3703	3859	6562
Montgomery, Alabama	392	487	515	932	1452	1284	1884
Nantucket, Massachusetts	920	994	1026	2618	2919	2938	5957
Nashville, Tennessee	686	793	812	1757	2425	2175	3507
New Haven, Connecticut	1001	1122	1110	2802	3395	3219	5895
New Orleans, Louisiana	300	336	332	575	846	735	1024
New York, New York	865	963	1028	2307	2859	2884	5274***
†Nome, Alaska	2046	1908	1857	5267	5387	5236	14580**
Norfolk, Virginia	497	681	738	1318	1945	1933	3350
North Head, Washington	776	652	725	2710	2556	2510	5452**
North Platte, Nebraska	1078	1034	1300	3537	3612	3786	6366
Oakland, California	644	556	527	1851	1612	1626	3143**
Oklahoma City, Oklahoma	820	798	865	1970	2231	2244	3613
Omaha, Nebraska	1127	1191	1355	3268	3793	3639	6131
Oswego, New York	1158	1216	1277	3235	3781	3771	7088
Parkersburg, West Virginia	787	898	992	2226	2887	2822	4775
Peoria, Illinois	1133	1170	1283	3078	3802	3606	6109
Philadelphia, Pennsylvania	781	926	962	2100	2724	2661	4737***
Phoenix, Arizona	449	424	409	1033	1045	990	1405
Pittsburgh, Pennsylvania	892	956	1054	2564	3056	3003	5235
Pocatello, Idaho	1439	1319	1218	4191	4154	3867	6655
Portland, Maine	1349	1401	1321	3853	4319	3926	7218
Portland, Oregon	803	695	806	2552	2338	2530	4469
Providence, Rhode Island	983	1083	1116	2676	3196	3246	6015
Pueblo, Colorado	1103	1042	1060	3409	3404	3224	5514
Raleigh, North Carolina	533	705	722	1471	2090	1975	3234
Rapid City, South Dakota	1161	1128	1320	4140	4039	4021	7118
Reading, Pennsylvania	860	993	1088	2422	3016	3102	5389
Red Bluff, California	682	594	(a)	1803	1644	(a)	—
Reno, Nevada	1041	974	1042	3547	3240	3326	5892
Richmond, Virginia	614	809	831	1714	2373	2211	3695
Rochester, New York	1109	1202	1252	3193	3846	3666	6732
Roseburg, Oregon	804	704	744	2694	2250	2485	4428
Roswell, New Mexico	819	822	786	2125	2194	2296	3484
Sacramento, California	699	591	614	1854	1545	1610	2653
St. Joseph, Missouri	1037	1082	1187	2769	3352	3147	5161
St. Louis, Missouri	854	936	1060	2217	2912	2798	4585
Salt Lake City, Utah	1330	1182	1110	3755	3565	3259	5555
San Antonio, Texas	516	496	381	1025	1120	854	1202
San Diego, California	358	275	332	865	687	819	1645
Sandusky, Ohio	992	1084	1181	2735	3367	3323	6208
San Francisco, California	556	424	465	1578	1305	1414	3264**
Sault Ste. Marie, Michigan	1478	1521	1581	4601	5015	4828	9285**
Savannah, Georgia	235	376	409	649	1161	1007	1490
Scranton, Pennsylvania	991	1093	1172	2896	3468	3446	6129
Seattle, Washington	813	675	781	2728	2402	2650	4934**
Sheridan, Wyoming	1227	1160	1431	4313	4117	4629	8008
Shreveport, Louisiana	556	572	555	1192	1522	1324	1938
Sioux City, Iowa	1247	1332	1435	3888	4331	4018	6898
Spokane, Washington	1262	1061	1172	4027	3708	3755	6355
Springfield, Illinois	980	1049	1181	2667	3299	3183	5373
Springfield, Missouri	909	944	973	2398	2921	2647	4428
Syracuse, New York	1157	1228	1277	3285	3875	3768	6893
Tacoma, Washington	851	721	812	2946	2662	2763	5181**
Terre Haute, Indiana	918	1034	1070	2474	3202	2910	4872
Toledo, Ohio	1076	1151	1203	3072	3709	3392	6077
Topeka, Kansas	993	981	1135	2650	3092	3018	4969
Trenton, New Jersey	833	970	1014	2328	2939	2774	4933
Utica, New York	823	1233	1248	2814	4088	3785	6796
Valentine, Nebraska	1204	1148	1370	3997	4040	4095	7039
Walla Walla, Washington	1015	795	989	3123	2759	2898	4808
Washington, D. C.	708	863	970	1958	2593	2711	4626
Wichita, Kansas	960	930	1094	2543	2877	2877	4673
Williston, North Dakota	1441	1549	1805	5186	5580	5463	9323
Winnemucca, Nevada	1223	1068	1150	3848	3543	3739	6427**
Yakima, Washington	1154	954	1159	3787	3228	3587	5599

(a) Data not available.
†Nome data are for December.

*Includes August.
**Includes July and August.
***New 48-year normal covering 1898 to 1946.

[1]Figures in this column are normal totals for acomplete heating season, September to June, incl.





DUST-STOP Filters in the Bryant (Model VB) Winter Air-Conditioner installed in the Parklake Apartments, Boston, Mass. (above). Each of the 151 suites is equipped with its own warm-air heating unit and duct system, permitting independent, automatic control of temperatures by the occupants of each apartment. The Parklake was designed by Saul Moffie, architect, and built by Cline Construction Company. The P. A. Dolan Company was the heating contractor.

Look at this combination of

Warm Air Heating Values

Public recognition of the "extras" in comfort, convenience and economy offered by modern warm-air heating has been demonstrated in several recent surveys among present and potential owners of single and multiple dwellings.

The comforts in living provided by today's winter air-conditioning systems are made possible by this exclusive combination of values:

1. **WARM AIR,** with room temperatures quickly responding to automatic controls.
2. **CLEAN AIR**—Filtered at the heating unit, all heat delivered throughout the warm-air duct system is free of nuisance dusts, lint and most air-borne bacteria.
3. **MECHANICALLY CIRCULATED AIR** keeps warm air fresh and clean while providing the proper number of air changes per hour.
4. **HUMIDIFIED AIR** affords greater physical comfort at lower room temperatures.

Architects and builders who specify and provide modern warm-air heat know that circulating air will be cleaned efficiently. For DUST-STOP* Filters, a Fiberglas product, are the choice of most manufacturers as original equipment. They're the homeowner's choice, too, for replacement DUST-STOPS are readily available at low cost through suppliers in every community.

For complete information on DUST-STOPS, see Sweet's Files or write: Owens-Corning Fiberglas Corporation, Dept. 912, Toledo 1, Ohio. Branches in principal cities.

In Canada: Fiberglas Canada Ltd., Toronto, Ontario.

*T. M. Reg. U. S. Pat. Off.

OWENS-CORNING
FIBERGLAS
T.M. REG. U.S. PAT. OFF.

MEMBER NATIONAL WARM AIR HEATING AND AIR CONDITIONING ASSOCIATION INDOOR COMFORT

NEWS OF THE MONTH

REFRIGERATION FAILURE

is said to have caused Los Angeles explosion which killed 15 people and damaged 300 bldgs.

Failure of a refrigeration system used to keep the temperature of a newly developed chemical solution below its known exploding point was designated by investigating authorities as the direct cause of a blast which on February 12 wrecked the plant of the O'Connor Electro-Plating Corp., Los Angeles, killing 15, injuring more than 150 and causing damage to some 300 nearby buildings estimated at between 1½ to 2 million dollars.

• **EXPERIMENT.** — Investigation by the Los Angeles Police and Fire Department Arson Squads and insurance company detectives disclosed that the O'Connor Corp. had been experimenting with the use of a solution composed of perchloric acid and acetic anhydride which was being used for electrolytic polishing of aluminum.

This type of mixture, it was pointed out, must be kept under constant refrigeration because it will usually explode if its temperature is permitted to rise above 80F. Need of an efficient cooling system was emphasized because a plating plant the size of the O'Connor shop usually contains from half a dozen to a score of large tanks filled with various types of solution in which metal parts are dipped. Room temperature, even in mechanically ventilated plating shops, frequently rises to 90 to 100F in the immediate vicinity of the larger heated tanks.

• **WARNED.**—While the complete destruction of the plant and the virtual disintegration of its equipment rendered a 100% definite determination of the origin of the explosion difficult, Los Angeles investigating authorities declared that an employee who survived the blast had disclosed that the 15 men and women employees had been told that the refrigeration system had balked and were bolting from the shop seconds before the acid tank blew up. The force of the explosion literally blew the entire one-story brick factory building into small pieces and tossed debris a distance of four blocks. An estimated 250 to 300 buildings in a 1½ block area were damaged in varying degrees.

• **TWO THEORIES.**—A second theory of causation was eventually discarded in favor of the one cited above. In speculating upon the probable cause of the explosion, leading Southern California chemical authorities who were consulted by the investigators agreed that the properties of perchloric acid were such that contact with it of any organic substance would precipitate an explosion.

This theory was accorded credibility for a while when a surviving employee reported that the iron hangers on which the aluminum parts were suspended for dipping into the acid tank, had shortly before the explosion occurred been replaced with plastic-coated hangers. Plastic, being an organic compound, could have caused the perchloric acid to detonate, the chemists declared.

Greater credence was subsequently given to the failure of the refrigeration system to maintain the acid within controllable temperature range, and this was ultimately accepted as the most likely cause.

John J. O'Connor, co-owner, reported that Robert M. Magee, chief chemist of the company, had been experimenting with a process for brightening aluminum, which was accomplished by immersing the metal parts to be plated in a solution of perchloric acid and acetic anhydride, followed by an electrical charge, which eliminated the need for manual buffing and polishing.

The bodies of Magee, and assistant chemist Alice Shemeta Iva, are the only ones not found. They are believed to have been blown to bits.

From last September, when Magee first started working with perchloric acid, the mixture had been kept in a 56-gallon crockery jar, O'Connor declared. A new solution of 350 gallons was mixed by Magee and O'Connor over the February 8 and 9 weekend, according to O'Connor. This was placed in a new iron tank measuring 4x4x16 ft which was mounted on 12-inch-thick glass blocks set upon the foot-thick concrete floor of the shop.

• **COOLING NEEDED.**—A cooling system was installed last fall to service the early batches of solution and was hooked up February 9 to the new tank, O'Connor declared. He asserted that while he knew of Magee's experiments, he was entirely unaware of the highly explosive nature of the solution which the chief chemist had developed through a combination of perchloric acid and acetic anhydride.

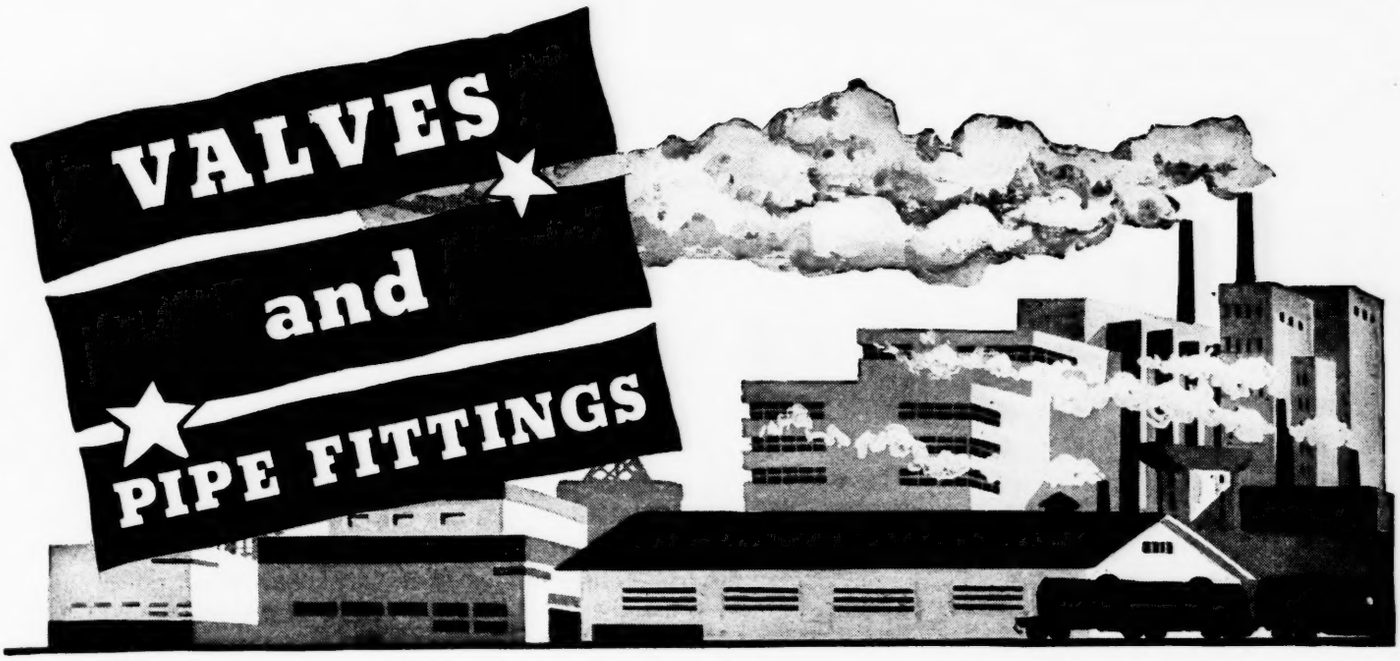
The Los Angeles City Council on February 14 adopted a resolution calling for a special investigation of all industrial and commercial establishments in which dangerous chemicals and other products are handled. The investigation, it was reported, will be devoted to a close scrutiny of all electro-plating plants and laboratories in the city to ascertain if other shops are using the dangerous perchloric acid solution without adequate cooling systems.

BOILERS ON ROOF

installed to heat Dallas building when utilities were disconnected after ownership transfer.

One of the highest installations of boilers ever made took place in Dallas when two steel heating boilers, with capacities of 24,290 sq ft of direct steam radiation each, were placed atop the 18-story Kirby Building.

• **HISTORY.**—This departure from ordinary heating techniques was necessitated by the fact that the Kirby Building was constructed adjacent to and long was



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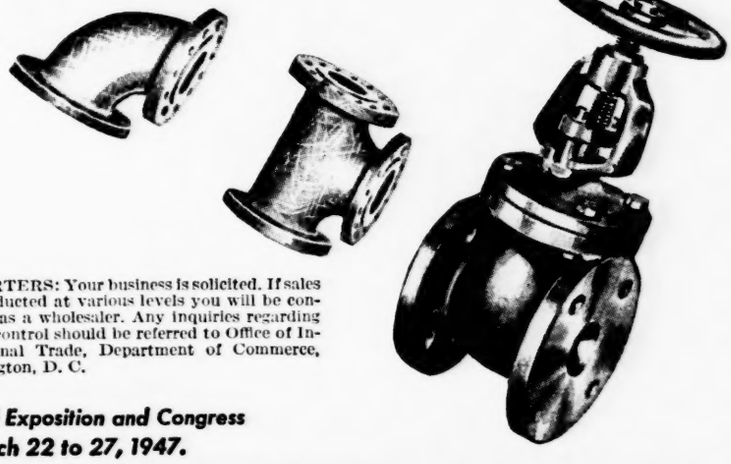

While every Regional Office has a supply of valves and pipe fittings, the largest inventories are located in these cities:

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All valves and fittings are sold under existing priority regulations of WAA and of the National Housing Expediter. VETERANS OF WORLD WAR II are invited to be certified at the War Assets Administration Certifying Office serving their area, and then to purchase the materials offered herein.

EXPORTERS: Your business is solicited. If sales are conducted at various levels you will be considered as a wholesaler. Any inquiries regarding export control should be referred to Office of International Trade, Department of Commerce, Washington, D. C.

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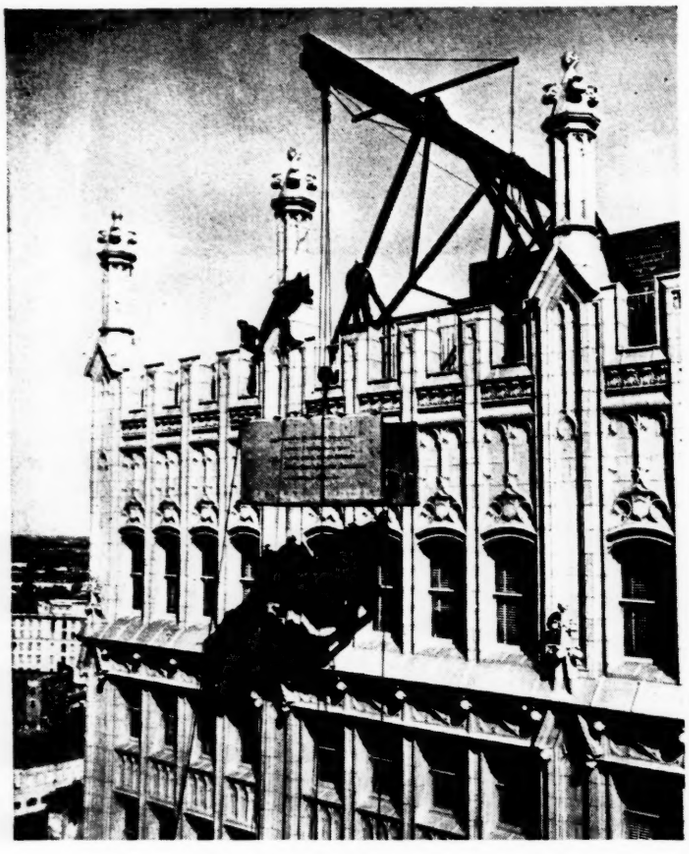
dependent upon the Adolphus Hotel for waste steam. In the Adolphus Hotel was installed an electrical generating plant which supplied both buildings with electricity and steam. In addition, water for both buildings was obtained from wells drilled beneath the hotel.

Several years ago, other interests purchased the Kirby Building, and very recently the electrical



Boiler base nears its goal atop the Kirby Building in Houston.

generating plant was displaced and the Kirby Building management was forced to turn to public utilities for heating, electricity, and water. The electricity and water problems were solved with no difficulty. But the problem of heating presented a much more complex problem. The rental value of the Kirby Building basement was such that boilers could not be installed there, nor was it practical to construct a sub-basement. Zumwalt and Vinther, consulting engineers of Dallas called in to work out a solution, decided that the roof was the only available place to put the boilers.

• **FUEL.**—First choice for fuel in the Southwest is natural gas, which can be piped to the roof of the 18-story structure without difficulty. The second choice is oil which also can be piped to the roof.

• **PUMPS.**—A basement pump is used to return condensate from the basement to the roof. It is of the regenerative turbine type directly connected to a 5 hp motor and furnished with magnetic starter and automatic switch. Condensate pumps in the penthouse are of the vertical type with receiver and were installed with basin top six inches above the finished floor of the penthouse, with the receiver projecting into the attic. Each has a rating of 40,000 E.D.R. and the two pumps are arranged as a duplex unit with receivers cross-connected near the bottom.

• **CONTROLS.**—The condensate pump in the basement starts and stops under control of a float switch installed on the side of a former air receiver converted to a condensate receiver. Condensate pumps in the penthouse are controlled from water level control switches installed on the boilers. The wiring is arranged in such a way that either boiler can be electrically switched to control either pump or both pumps simultaneously.

The receiver of one of the penthouse pumps is provided with a ½-in. float control installed in the attic near the bottom of the vessel to admit make-up water. The make-up water is obtained from a domestic cold water supply main in the attic, but the tap was brought above the penthouse floor and valved.

In operation, the boilers can be filled by means of a manual line. Level is maintained by the float switches on the boilers as long as water is available in the receiver. Should sufficient condensate not accumulate to satisfy the demands of the boilers, the water level in the receivers will fall until the float valve opens to admit the deficiency.

A complete system of automatic temperature regulating equipment, pneumatic in operation, was installed, and includes all master and sub-master thermostats, valves, air compressor, relays, switches, piping, etc. Summer and winter operations were taken into consideration.

Each of the boilers is adapted to gas fuel and has a heating surface of 1,429 sq ft. Each was built for 15 lb working pressure and in accordance with ASME Code. The boilers were set on fire brick flatways which were placed on top of a layer of 4-in. hollow tiles that were arranged end to end to permit passage of air flow. The boilers were manufactured by Pacific Steel Boiler Division of the United States Radiator Corp. Since the Kirby Building was constructed without a chimney the contractors installed on each boiler an induced draft fan.

Each fan is adapted to high temperature use by the application of high temperature ball bearings and heat flinger with ability to handle 3,600 cfm of 500F gases at a total pressure of one-inch and with an outlet velocity not exceeding 2,000 fpm. All radiation in the office building, except the toilet risers, was removed and replaced by a new system

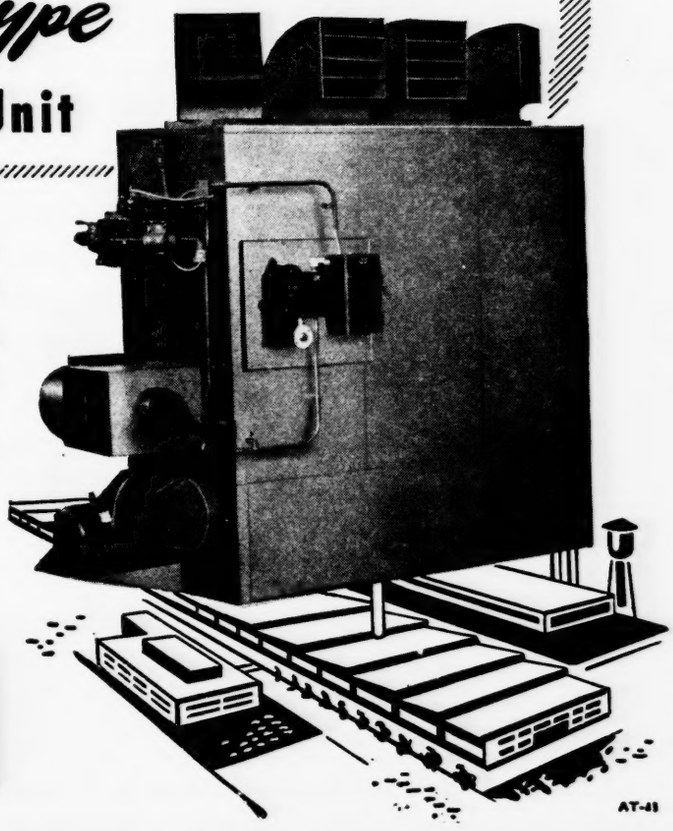
UNIFORM PLUMBING CODE

urged by housing committee will be furthered by Bureau of Standards demonstration.

A committee representing the plumbing industry, labor and the government and sponsored by the Office of the Housing Expediter and the National Housing

AIRTHERM DIRECT-FIRED WARM AIR HEATER

The Most Efficient Type of Factory Heating Unit



Additional heating capacity for your plant without the necessity of disturbing your present heating system. Flexible enough to permit moving to new location for your future building program.

Capacities from 650,000 to 1,950,000 B.T.U.'s. Either oil or gas-fired.

✓Write for Bulletin 801 describing this economical heater in detail.

AIRTHERM MANUFACTURING COMPANY

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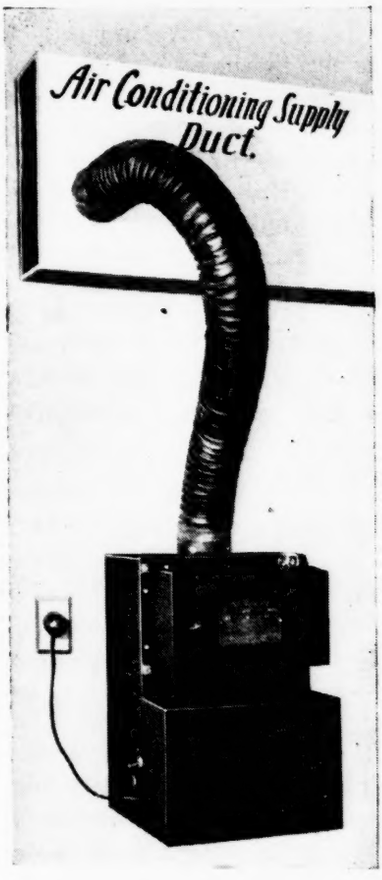


modernize YOUR AIR CONDITIONING WITH ULTRA-VIOLET OZO-RAY!

1. Fundamentally different method of ultra-violet air purification . . . . without tubes!
2. Destroys objectionable organic odors, eliminates smoke, gases—provides "mountain-fresh" air.
3. Easily installed in existing ventilation ducts or plenum chambers.
4. Plugs into standard electrical outlets, 110 Volt, A.C.
5. Cuts fuel costs by reducing necessary intake of outside air.
6. Needs little attention Operating costs low.
7. Continuous operation with NO arcing, sparking or destructive heat.

⇦ EASILY INSTALLED

LEFT: One of the many varied methods of installing OZO-RAY equipment into ventilating ducts. Where a whole building, or section of it, is to be OZO-RAY equipped, units are quickly and easily set into air ducts at strategic points, without disturbing existing equipment in any way. To service a single room, just plug an OZO-RAY wall model of appropriate capacity into any standard electrical outlet.

DESTROYS STOCK YARD ODORS!

"Our office is located in the stock yard, with its odors, none of which could be removed by either oil filter or water bath. This OZO-RAY generator has accomplished everything we had hoped it would. It has removed the unpleasant odors." (Libby, McNeill & Libby).

PURIFIES AIR IN CRACK TRAIN!

"The OZO-RAY equipment installed in the Green Diamond has given satisfactory service in removing smoke and odors, especially stale tobacco smoke odor that clings to curtains and upholstery." (Illinois Central System).

REMOVES FLOWER ODORS!

"Very effective in removing floral odors—has been proven the only effective aid to our air conditioning that we have ever been able to find." (Lain & Son, Chicago morticians).

OZO-RAY PRODUCTS MFG. CO., INC.

PLANT: Beacon, New York
OFFICE: 7 Dey Street, New York 7, N. Y.
(New York phone: BEekman 3-4500)

Agency is working on a uniform plumbing code which, it is hoped, will in time be used to standardize the numerous plumbing codes now in existence.

• **DEMONSTRATION.**—As a part of its work, the committee is making arrangements for an extensive demonstration project at the National Bureau of Standards in which clear glass or plastic piping will be used to duplicate working conditions in a plumbing system in order to permit observation of the tests. Moving pictures will be made of the tests and the results will be recorded in a technical report. Both the movie and the report will then be made available to any city or municipality or to anyone in the industry.

• **COMMITTEE.** — Committee members are Henry Blank, National Association of Master Plumbers; Herbert L. Schaller, United Association of Journeymen and Apprentices of the Plumbing and Pipefitting Industry; George N. Thompson, National Bureau of Standards; Lieut. M. C. Hope, U. S. Public Health Service, and Vincent Manas, representing the office of the Housing Expediter and the NHA, chairman. The testing program is being expedited by the Technical Office of the National Housing Agency, of which William V. Reed is director.

ASME BOILER CODE

Section VIII on pressure vessels redrafted; Committee asks comments; Public hearing planned.

The Boiler Code Committee of The American Society of Mechanical Engineers announces that its special committee to revise section VIII of the ASME Boiler Construction Code (Unfired Pressure Vessel Code) has completed its work and has submitted a report to the boiler code committee in draft form as a proposed revision of Section VIII.

• **ARRANGEMENT.**—One of the outstanding features of the new draft is the development of a more logical arrangement of material, which closely follows that in the API-ASME Unifired Pressure Vessel Code: The basic minimum requirements are essentially those established in the alternate rules for unfired pressure vessels, issued as a part of the 1944 addenda to the code. Besides improved arrangement, the proposed revision embodies the following additional features: (1) Improved and extended rules for the design of formed heads under internal and external pressure; (2) provision for the design of cylindrical shells under external pressure at elevated temperature; (3) joint efficiency for fusion welded vessels established on a premium basis; (4) spot examination of fusion-welded vessels as a minimum requirement; (5) incorporation of a non-mandatory appendix as a guide for the inspection of vessels in service.

• **NOT FINAL.**—It should be noted that the proposed revision in no way affects the forthcoming issuance of the 1946 edition of the Unfired Pressure Vessel Code. There is no indication at present as to the date of final adoption of the proposed revision.

The boiler code committee invites all interested persons to review the proposed revision and to submit comments thereon to the committee. The new draft is obtainable from J. W. Shields, secretary of the committee, ASME, 29 West 39th St., New York 18, N. Y., at $1 per copy.

• **HEARINGS.** — The committee plans to hold several public hearings on the proposed revision of section VIII before final consideration for adoption. The first hearing has been tentatively scheduled for Houston, Tex., on May 1, to be followed by another in Los Angeles, Calif., on May 7. Those interested are invited to attend and to participate. Further information concerning these hearings may be obtained from the secretary of the committee.

GORGAS MINE

is set afire in experimental effort to produce gas underground.

On January 21 incendiary bombs were dropped into holes drilled into an isolated seam of coal at the Gorgas Mine of the Alabama Power Company, forty miles northwest of Birmingham.

• **TUBE.**—The experiment is proceeding under the direction of the Alabama Power Company and the U. S. Bureau of Mines. Air is supplied through a U-shape tunnel drilled horizontally through the coal seam, and forces gas out of the mine from the combustion area at the base of the U. (H&V:2:47:p 109)

When the incendiary bombs were dropped into the hole, the coal caught fire and thermocouples registered temperatures as high as 2,000F before they burned out. The fire has been burning ever since.

• **HOPES.**—The fire is expected to burn until about the second week in March during which time further tests are planned. Gas will be piped directly to a boiler and used to make power. The experimenters hope to borrow a blimp from the Army and store large volumes of the gas for analytical studies. When the fire goes out, the bulldozers will scrape away the top of the hill. If nothing but ashes is left, it will mean that all the value of the coal has been extracted, and that the process is not unduly wasted.

HOT WATER AND STEAM

pushed as I-B-R launches comprehensive consumer advertising campaign.

A comprehensive advertising campaign to place the full story of the many advantages of hot water and steam heating prominently before the public is announced by the Institute of Boiler and Radiator Manufacturers. Contracts for advertisements have been placed to run for every month starting in February in *Better Homes and Gardens, American Home, House Beautiful, House and Garden,* and the *Small Homes Guide.*

• **BOOKLET.**—The purpose of these advertisements is to tell the consumer that a 24-page booklet "Enjoy

TYPE 4-F
Standard set for heating ventilating—air conditioning air velocity measurements

Alnor VELOMETER

DESIGNED especially to meet the needs of architects, engineers, contractors, sheet metal workers, who need a reliable fast means of measuring air movement. This Velometer is easily used for balancing heating systems, ventilating and air conditioning installations. It measures the air velocity at supply grilles; air intake at cold air returns; static pressure; and can be used to find drafts or leaks around doors and windows. The Alnor Velometer is a direct reading air velocity meter — instantaneous — easily used anywhere.

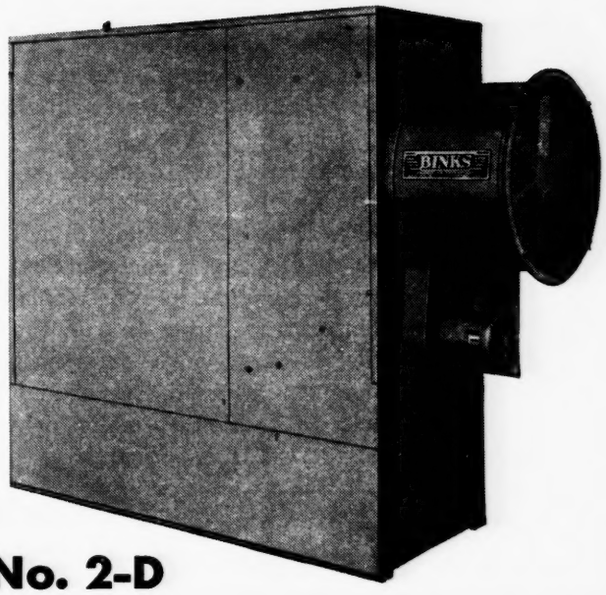
Type 4-F Velometer set, with all attachments for the above work, in carrying case, price $82.50 f.o.b. Chicago. Order now for prompt delivery. Velometer bulletin sent on request.

Illinois Testing Laboratories, Inc.

420 North LaSalle Street
Chicago 10, Illinois

INDUCED DRAFT COOLING TOWERS

34 STANDARD SIZES



No. 2-D

Binks No. 2-D Horizontal Induced Draft Cooling Towers are *all-purpose* water cooling units for use indoors or outdoors where water conservation is important and where natural air movement is inadequate. The spray principle of water distribution is used. The No. 2-D provides the correct ratios of air to water and travel flow to give maximum cooling at lowest cost. Single fan sizes are available with capacities from 3 to 150 G.P.M. Twin fan models have capacities from 180 to 300 G.P.M.

There's a Binks Cooling Tower for every water cooling job.

WRITE NOW FOR BULLETIN No. 601

Bulletin No. 601 is a 12-page descriptive booklet packed with specification data, dimensions, helpful charts, etc. about Binks No. 2-D Horizontal Induced Draft Cooling Towers. Drop a postcard in the mail today for your free copy.

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Offices in all principal cities

Better Living With Radiant Sunny Warmth" is available free to the public. Illustrated in four colors, the booklet is a non-technical presentation of radiant heating. It points out that the advantages of radiant heating are available through the use of radiators, radiant baseboards, panels, and convectors.

• **BROADSIDE.**—Full details of the campaign were announced to the trade in a broadside sent to distributors of heating equipment, heating and piping contractors and dealers, engineers, architects, and builders. A copy of the consumer booklet will be sent with the broadside. Full details will be given in the broadside on how members of the trade may purchase a supply of the booklets for their own use as a selling tool in dealing with the consumer.

• **TRADE ADS.**—Distribution of the broadside will be followed by advertisements in 13 trade papers and association publications. The advertisements will be in two colors occupying a full page in each publication.

A. E. Ferry, general manager of the Institute, points out that the campaign is unique in that for the first time a joint effort is being made on a national scale by a group of manufacturers of steam and hot water heating systems to influence public demand for their products.

GAS INDUSTRY

gains freedom of action in FPC ruling on natural gas.

The Federal Power Commission has yielded to one demand voiced by the natural gas industry and will divide the country up into service areas. Each interstate company will be allowed to make limited extensions of service within areas where it is already doing business. These extensions may be made without obtaining FPC approval on each transaction.

This service area plan has grown out of FPC's fifteen month investigation court covering the natural gas industry. The plan has been authorized by Congress in an amendment to the Natural Gas Act of 1942.

Members of the industry are loud in their approval of this new freedom of action. FPC, however, complains that its staff is too small to undertake defining areas.

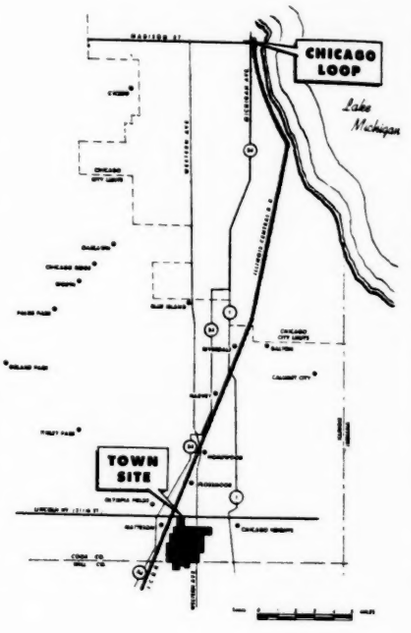
CENTRALIZED PROJECTS

in real estate development characterize modern trend in residential, commercial and institutional construction.

The pace set by the heavy investment of life insurance money in great housing projects (H & V:2:46: page 101) is being followed by at least two private real estate agencies as well as by a new construction project at Harvard University.

• **CHICAGO.**—A $70 million city will be constructed on 2300 acres of land near Olympia fields, 55 minutes from Chicago's Loop, according to plans announced by the American Community Builders, Inc., of Chicago.

Phillip M. Klutznick, president of the Chicago concern and former commissioner of the Federal Public Housing Authority, declared in making the announcement of plans that the town would provide housing for 25,000 middle income residents. Actual construction of homes will begin after the winter weather. Financing will be done under the FHA plan. The project is to be an integrated community of homes with shopping centers, schools, recreation facilities, and non-nuisance industry. Present plans call for houses selling for 7 to $10 thousand with provision for 600 rental units. The initial program will accommodate 5,500 families and later expansion is planned for approximately 3,000 more. Construction will be divided among single, double and multi-family units, divided into five contiguous residential neighborhoods.



Elbert Peets of Washington, D. C., who collaborated in the planning of the towns of Kahler and Greendale near Milwaukee, designed the basic plan for the community in conjunction with the architectural firm of Loebel and Schlossman. Allen S. Harrison (H & V 3:46:page 95) of New York City heads the construction division.

• **FLUSHING, NEW YORK.**—New York's most spectacular real estate man, William Zeckendorf, 41-year-old executive vice-president of Webb & Knapp, Inc., New York City, has teamed up with Lester Ticky, architect, to produce a $50,000,000 project which will transform the heart of Flushing, New York, into a shopping and amusement center for a good part of suburban New York, according to a report in "The Architectural Forum."

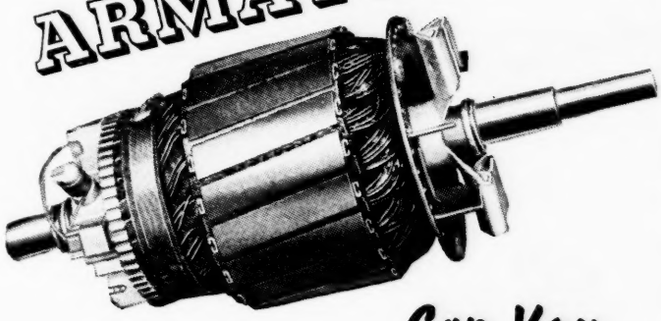
A 23-acre site, almost all of which has already been purchased by Zeckendorf, is ideally situated from the transportation standpoint since it includes important bus, subway, and railroad stations and is served by a network of highways and parkways reaching all of Long Island and crossing nearby bridges to link with Manhattan, the Bronx, and Westchester.

The project will cater to the public's every mood and whim. A large department store, three office buildings, and a 5,000-seat theatre will look down on seven blocks of modern shops and markets served by a mile of covered air conditioned sidewalks, 5,000 covered parking spaces, and 4,000 feet of subterranean moving sidewalks.

• **SCOPE.**—In addition to buildings already mentioned including about 60 small shops for all types of mer-

Let's Talk About

ARMATURES!



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5. New rocker arms and brush holder assemblies with brushes.

And Are:

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Order Your New Wagner Armatures Today

Every motor repair shop needs this catalog. It helps you determine the catalog number and price of Wagner fast-moving motor parts. Write for Catalog MU-40 today.

Wagner motors are world-famous for dependable service. When repairing a Wagner motor, be sure to use *genuine* Wagner motor parts, designed and built to renew that dependability. Get them from one of the 325 authorized service stations displaying this sign.

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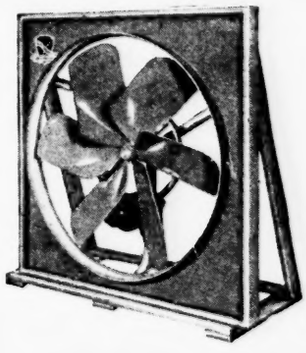
Beg for Breezes?

Have customers ever begged for dependable, inexpensive breezes for their homes . . . Are you looking for an appliance that will assure summer comfort for your customers and profits for you? Then you should know about BAR-BROOK BREEZEBUILDER Attic Fans—cooling comfort for new or old homes, factories, schools, and offices. BAR-BROOK Fans enjoy established customer acceptance, sell as simple package units, and give dependable, trouble-free performance year after year.



Write for information about BAR-BROOK BREEZEBUILDER Attic Fans — the efficient cooling appliance that makes breezes for your customers and profits for you.

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BAR-BROOK WINDO-WIND

BAR-BROOK MFG. CO., INC.

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SHREVEPORT, LOUISIANA, U.S.A.

BAR-BROOK BREEZEBUILDER

chants, the principal elements of the project will include a mail order house, 5 & 10 cent store, super market, gasoline station, plant nursery, dance hall, skating rink, and bowling alleys. Three, eight-story structures will serve as a professional building, an apartment hotel, and a general office building. All space except that in the eight-story buildings will be leased on a percentage basis whereby tenants pay small fixed monthly rents plus percentages of their gross annual incomes above specified levels. Preservation of the project's character is assured by the fact that no space will be sold. Webb & Knapp, who will manage the project from offices on the site, hope to gross $6¼ million dollars from annual rents—5% of the $125 million yearly retail business expected of their tenants. After taxes and other expenses, their anticipated net will be $1¼ million.

Webb & Knapp have already invested more than $15 million in land acquisition, which began late in 1941. About 90% of the necessary land has been assembled, the balance being so high priced as to require acquisition through condemnation with municipal assistance. Despite difficulties connected with present day non-residential building, Mr. Zeckendorf believes that construction of the Flushing project will get under way late in 1947 and be completed by 1950. Backing the project is the Metropolitan Life Insurance Company, which has already loaned two million dollars and has an option on a $35 million construction loan.

Among recently announced projects for New York City, this center ranks second only to another of Zeckendorf's real estate giants: a $100 million commercial city for 100,000 people and 10,000 automobiles to be built on midtown Manhattan's east side.

• **EDUCATION.**—In the educational field, Harvard University plans a "Science City" in Cambridge, Mass. The scientific and technological resources of Harvard will be integrated with new buildings and equipment under new coordination of scientific staffs. The central science center building, now in the blueprint stage, will become the axis of the new Science City. In many cases, existing laboratories will be joined to the new science structure and scientists in many fields will be brought together in close association. Laboratories now under construction, such as the computation laboratory with its mechanical brain and the cyclotron house with its new atom smasher, have been strategically located in reference to the centralization plan. The whole area will be within a radius of about one quarter of a mile. The first building in the center, which will be built with funds now available, will be about 500 feet long and four or five stories high. It will house all the branches of applied physics, geophysics, mathematics, astronomy and other groups. The first section of the new building will be devoted to laboratories for the new department of engineering, sciences and applied physics. Professor Frederic B. Hunt of this department will be in charge as chairman of the new building planning committee; working with him are Coolidge, Shipley, Bulfinch, and Abbott, architects.

STOKERS LEAD

in number of fuel-burning permits issued in Chicago last year. Margin of lead is less than year previous.

Installations of underfeed stokers for commercial and industrial jobs where permits are necessary in Chicago numbered 1,959 or 66% of a total of 2,966 permits issued by the city last year. Underfeed stoker installations in 1945 totaled 2,316, or 85½% of the total of 2,712 permits issued in that year.

• **OIL GAINS.**—Permits for commercial and industrial fuel-oil burning installations in 1946 showed a very substantial increase over 1945—a total of 814 installations accounting for 27½ per cent of the total permits issued, compared with 288 installations in 1945, or 10½% of the total permits.

AIR CONDITIONING CONFERENCE

in Oregon will bring statewide industry together for fourth consecutive year.

The fourth annual Oregon State Air Conditioning Conference will be held March 27 to 29 at Corvallis. The conference is sponsored by the Oregon Chapter of the ASHVE and the Department of Mechanical Engineering at Oregon State College. The conference will consist of a program of talks and an exposition of heating and air conditioning equipment. Significantly, included on the Saturday schedule will be talks on the heat pump and electric heating. Warm air and panel heating methods will have their share of attention.

$2,000 in Prizes for Papers on Resistance Welding

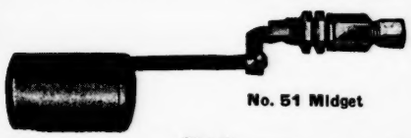
Subject: Significant information on theory and practice in the field of resistance welding.

Form: Minimum length, 2,500 words; typewritten, double spaced on one side of white paper; figures attached to copy or separate and numbered. Papers mailed to arrive before July 1 should be in triplicate. If mailed to arrive between July 1 and July 31, six copies should be furnished. Contest closes at midnight, July 31, 1947. Papers should be sent to: American Welding Society, 33 West 39th Street, New York 18, N. Y.

Eligible: Those employed in industry, consulting engineers, private or government laboratory workers, etc. Also university instructors, students, research fellows, etc.

Prizes: Industrial class; 1st prize $750; 2nd, $500; 3rd, $250. University class; 1st prize, $300; 2nd, $200. Prizes will be awarded at the 1947 fall meeting of the American Welding Society.

TRY THESE BETTER Float Valves



No. 51 Midget

7⅛"

Accurately maintains water line as low as 1" deep—thumb screw adjustment. Entire valve made of non-ferrous metals. Easy to install by drilling one hole. Capacity one quart per min. at 50 lbs. pressure; maximum pressure 75 lbs.

Built to Operate in Small Space and for All Service Conditions

Built like a watch to precision standards! . . . safe, trouble-free, inexpensive float valves for WATER LEVEL CONTROL in air conditioning units, evaporative coolers, pan fillers, etc. Send today for complete catalog and attractive prices.

No. 52 High-Duty

7½"

Same general design as No. 51—but built for larger capacities. Handles 1½ gals. per min. at 75 lbs. pressure; maximum 125 lbs. Fully adjustable.

No. 53 High-Duty Bracket Valve

Same construction and capacities as No. 52. Only difference is vertical mounting of valve as shown. Overall length 5 9/16".

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AUTOMATIC HUMIDIFIERS FOR ALL TYPES OF HEATING SYSTEMS

Get Extra Profits out of Radiant Heating by bending pipe on the job with Tal's Portable, Hydraulic Bender

• Bending pipe on the job is making **more money** for those contractors alert enough to get behind radiant heating with the right equipment—a Tal portable pipe bender. This best engineered machine bends cold to any angle all wrought iron or steel pipe ⅜" to 3" in one single, fast moving operation. It reduces the need for welds by from 40% to 80% — speeds up installation work. Used now by leaders who know it repays its low cost many times a year. Write for bulletin

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HYDRAULIC PORTABLE Tal's PRESTAL

Going Underground?

THEN YOU WILL WANT TO WRITE AT ONCE FOR INFORMATION ON THE NEW SIMPLIFIED MONOLITHIC CONDUIT WHICH ELIMINATES STRUCTURAL JOINTS AND VOIDS, DOES NOT REQUIRE DRAINAGE OR VENTILATION AND PROVIDES A PERMANENT WATERPROOF INSULATION.

UNIVERSAL ZONOLITE INSULATION CO.

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"Z"crete

Underground Pipe Insulation

Abstracts AND Reviews

PANEL HEATING ANALYSIS

Based on research at University of California and Purdue University, "Panel Heating and Cooling Analysis," a new book by Professors B. F. Raber and F. W. Hutchinson, has made its appearance. The authors are, respectively, chairman of the mechanical engineering division at California and professor of mechanical engineering at Purdue.

The book is composed of three relatively independent sections. Of a total of thirteen chapters, the first five are descriptive, generally non-technical, on background, development, advantages and disadvantages of panel heating and cooling. The greater part of the book, the middle seven chapters, is a detailed and rigorous treatment of the theory and mathematical analysis of radiant exchange. The concluding two chapters contain simplifications of the rational design procedure, including the authors' concept of equivalent conductance.

As the authors state in the introduction, the design procedure is applicable to hot water, steam, warm air or electrical radiant heating. The design data do not include the method of bringing the heat from the pipe duct or wire to the surface, as this is a commercial problem best solved by empirical methods developed by advocates of each method.

Chapter titles include the following: Types of Heating Panels; Advantages of Panel Heating and Cooling; Disadvantages of Panel Heating and Cooling; Radiation Equations; The Comfort Relationship; The Mean Radiant Temperature; Evaluation of Shape Factor: Planar Surfaces; Evaluation of Shape Factor: The Human Body; Evaluation of Shape Factor: Approximations and Examples; Heat-Balance Equations; The Equivalent Conductance Design Procedure.

Panel Heating and Cooling Analysis, by B. F. Raber and F. W. Hutchinson. 5¾ by 8⅝ inch, cloth bound, 208 pages. Published by John Wiley & Sons, Inc., New York. Price, $3.50.

THE LIMITIST

This is a legalistic, non-revolutionary solution of the problems besetting capitalism in the United States. The author, Fred I. Raymond, is the inventor of the first heat regulator actuated by outdoor temperature. As an executive in big business and, later, sole owner of a small business, he has observed the American economic scene first hand. His economic thinking is presented clearly and without the adulteration of foreignism in this small book.

The first part of the book discusses the ills of present day unlimited capitalism and points out that the thwarting of mechanisms for redistribution of wealth —inheritance, diminishing returns, financial upheaval, new enterprise, taxation — relied upon by classical capitalist theory has brought about an unhealthy giantism of both individual and corporate fortunes.

The second part proposes to reestablish the leveling effect of these classical mechanisms by enacting legislation limiting the size and scope of commercial and agricultural bodies.

Readers will enjoy poking little holes in small areas of Mr. Raymond's logic, but the sturdy structure of his thinking will survive this probing and will, at the very least, broaden the base of present day economic discussion.

The Limitist, by Fred I. Raymond. Cloth bound, 5¼ by 8¼ in., 166 pages. Published by W. W. Norton & Co., Inc. Price, $2.00.

CHEMICAL AND TECHNICAL DICTIONARY

About 50,000 terms are defined in the Concise Chemical and Technical Dictionary, edited by H. Bennett, Technical Director, Glyco Products Co., Inc. It includes a compilation of trade name or proprietary products in the synthetic resin, plastics, metal, rubber, textile, food, pharmaceutical, paint and varnish fields.

Data on chemical compounds includes chemical name, synonymous names, semi-structural formula, molecular weight, color and form, specific gravity, melting and boiling points, other physical properties, solubilities and uses.

An addenda lists the newest trade names and definitions of additional technical terms.

Concise Chemical and Technical Dictionary, edited by H. Bennett. Cloth bound, 6 by 9 in., 1055 pages. Published by Chemical Publishing Co. Price, $10.

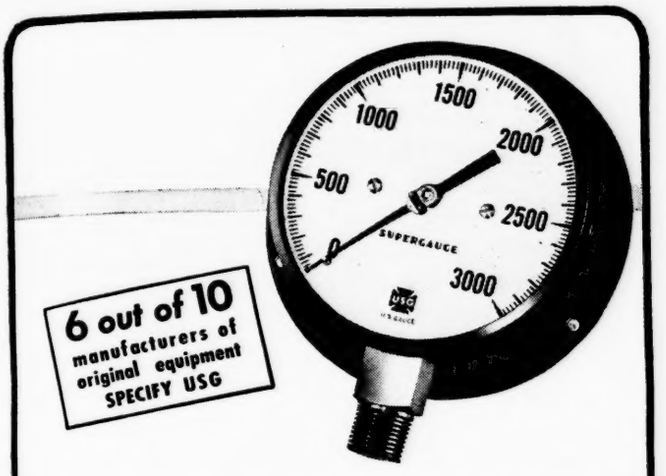
OIL HEATING HANDBOOK

Originally published in 1937, the Oil Heating Handbook by Han A. Kunitz is now available as completely revised and enlarged third edition. It is intended to answer questions that the home owner may have regarding oil heating, and the installation and maintenance of oil burners; to provide understandable data to students and oil burner men.

The volume is presented as a manual of theoretical and practical considerations entering into the manufacture, installation and use of oil burners in moderate size heating systems. The material is divided into five parts as follows: Oil Burner System and Classification; Combustion; Heating and Heating Systems; Surveys and Installations; Retail Selling; Forms, Tables and Terminology.

The text is well written and the material is easy to follow. The fact that the book is now in its third edition indicates the acceptance that this work has been given by the heating field.

Oil Heating Handbook, by Han A. Kunitz. Flexible cloth cover, 5 by 7½ in., 464 pages. Published by J. B. Lippincott Co. Price, $5.



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U.S. INSTRUMENTS Tell The Truth

UNITED STATES GAUGE

USG

DIVISION OF AMERICAN MACHINE AND METALS, INC., SELLERSVILLE, PENNA.
Manufacturers of Pressure, Temperature, Flow and Electrical Measuring Instruments

Flight-tested to 100 Degrees Below Zero with

FRICK

Refrigeration

Reports on the temperature, humidity, and pressure of the air are radioed back to recording instruments on the earth by the Bendix-Friez Radiosonde, carried to heights of 16 miles or more by a balloon. These "weather" reports proved invaluable to the United Nations during the War: thousands of Radiosondes were sent aloft each month.

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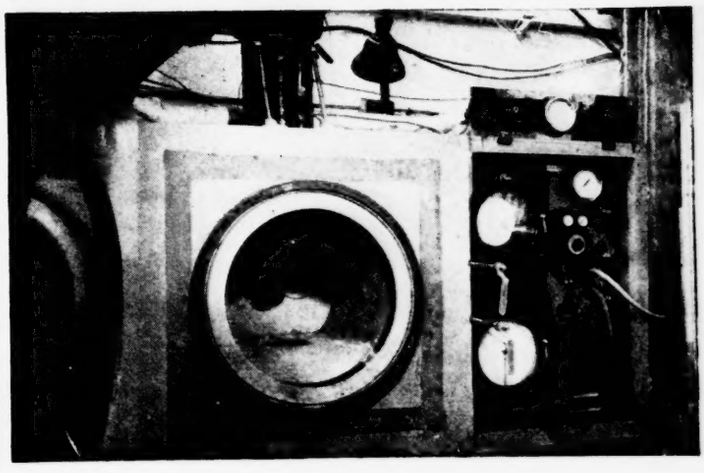

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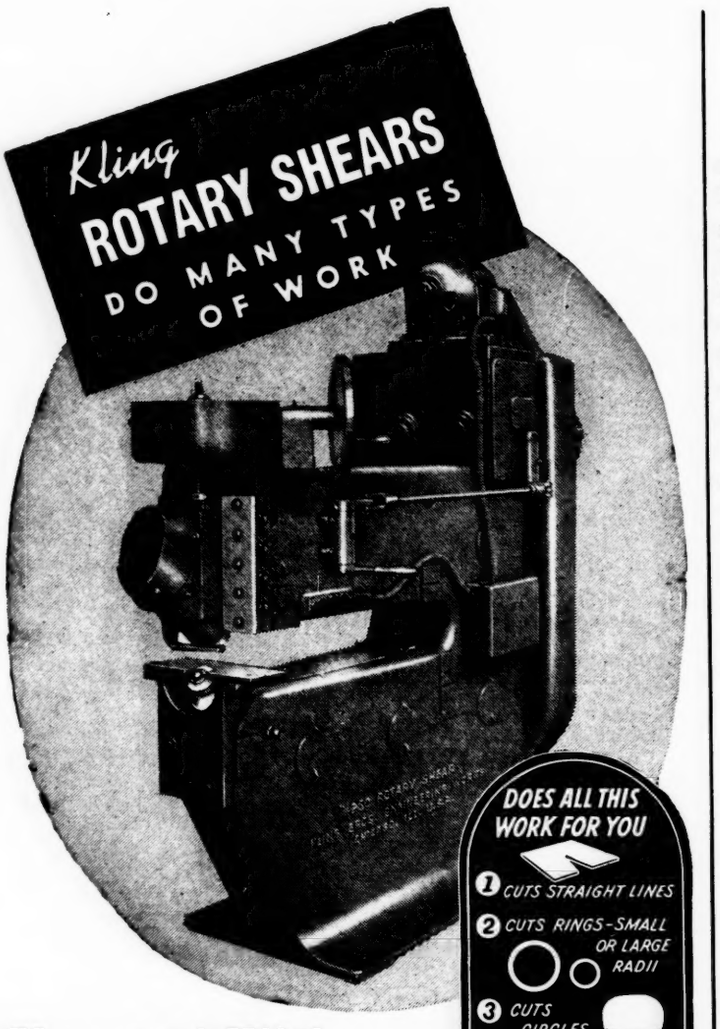

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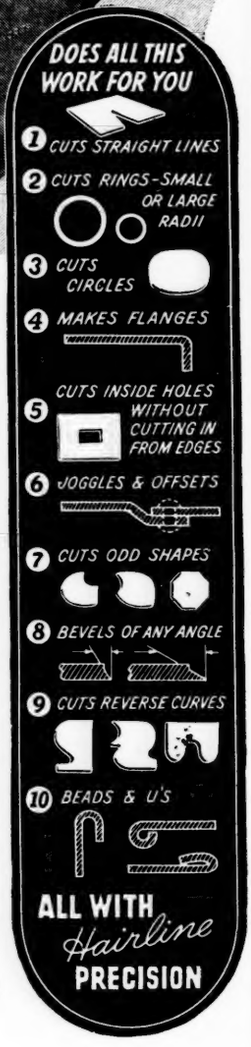
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REVIEWS

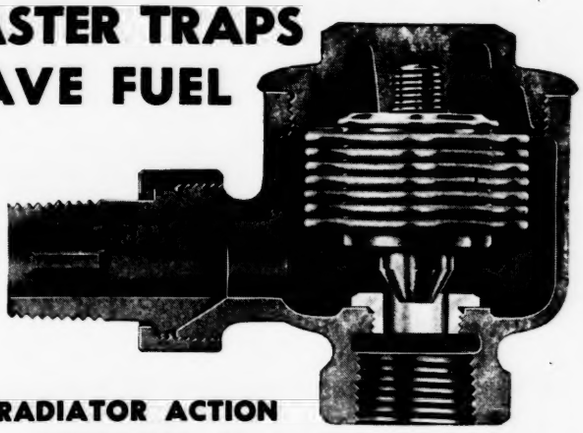
HOT WATER HEATING SYSTEM—The two-pipe reverse return gravity hot water system is presented as Installation Guide No. 4 by The Institute of Boiler and Radiator Manufacturers, 60 East 42nd St., New York 17, N. Y. Examples of procedure are given for both two-story and one-story houses. The booklet covers recommended installation practice, simplified design procedure, heat loss factors, Btu heat loss, square feet of radiation for various rates of heat emission, pipe sizing tables, sample calculation sheets and other data. In this hot water heating system, radiators are connected to the return main in reverse order from that in which they are connected to the supply main. The first radiator connected to the supply main is the last radiator connected to the return main. An advantage claimed for this system is that length of water circuit from boiler through any radiator and back to the boiler is the same as for any other radiator. Price of booklet, 25 cents.

PROBLEM OF ODORS IN INSTITUTIONS — Obnoxious odors in hospitals have long been a serious problem, and Dewey H. Palmer, the author of the report points out that there is a definite need for really effective deodorizers suitable for hospital conditions. He discusses the various means of removing or controlling odors, and the types of material available. In a study made by the Naval Medical Research Institute it was found "of the six commercial means of odor control evaluated, activated carbon was the only agent effective in reducing the odor level in the room to its original level." A filter cloth impregnated with activated carbon was found effective in adsorbing odors emitted by cases of osteomyelitis, cancer, burns and other infected areas. Copies of this 11-page report, at 50 cents, can be obtained from Hospital Bureau of Standards and Supplies, Inc., 247 Park Ave., New York 17, N. Y.

HEAT TRANSFER — An investigation regarding the Heat Transfer from a Vertical Plate to an Air Stream, by L. Slegel, formerly instructor in Mechanical Engineering, Purdue University, and G. A. Hawkins, Westinghouse Research Professor of Heat Transfer, Purdue University. The air stream flowed parallel to the plate surface at various velocities and temperature differences. Range of air stream velocities was from 32 to 66 fps, and the temperature differences was from 22 to 229F. Issued by Purdue University, Lafayette, Ind., as Research Series No. 97.

LEARNING TO WELD — Instruction is given in the repair of broken parts by means of arc welding. The booklet includes four pages and 22 illustrations of typical applications of arc welding in repair and construction. For copies of the 32-page booklet at 25 cents a copy, write to The Lincoln Electric Co., Cleveland 1, Ohio.

Nicholson's New Line of FASTER TRAPS SAVE FUEL



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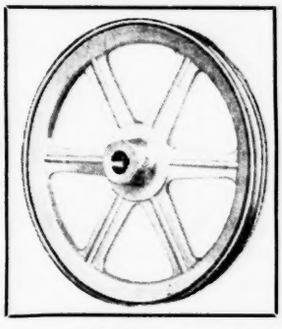

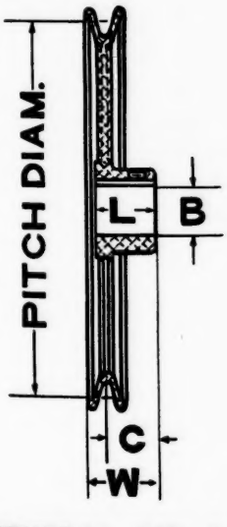

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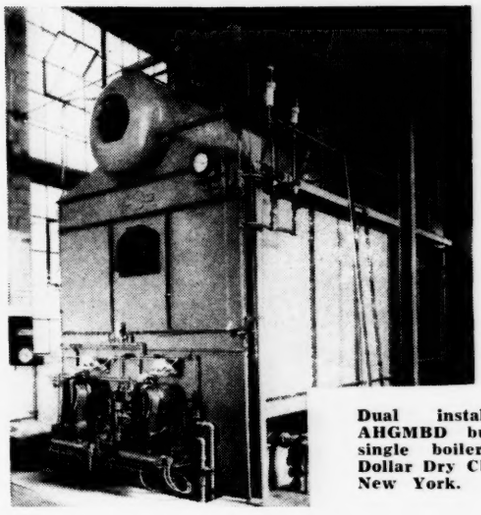

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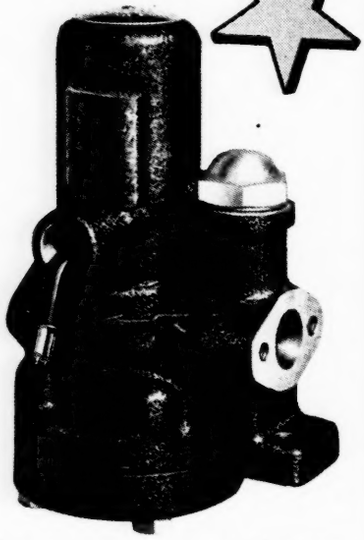

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NEW CATALOGS

Blast Coils

A new catalog describing "Grid" Blast Coils contains a detailed description of the one-piece, high test, cast iron construction of the fin heating sections, an exclusive feature. Diagrams of installations, performance charts, temperature differential conversion tables, physical data, and specifications are included in this catalog.—*D. J. Murray Mfg. Co., Wausau, Wis.*.....**203**

Pressure Oil Burners

An illustrated bulletin describes the Powermatic pressure oil burner featuring special controls for air and flame adjustment.—*Kresno Oil Burner Mfg. Co., 56 West 24th St., New York 10, N. Y.*.....**204**

Blower Wheels

Bulletin 403, 16 pages, in two colors, describes the Morrison Airstream blower wheel. Includes construction diagrams, materials specifications, performance charts, etc.—*Morrison Products, Inc., East 166th & Waterloo Rd., Cleveland 10, Ohio*.....**205**

Blowers and Fans

A 4-page bulletin which describes a general line of blowers and fans, exhausters, and roof ventilators, under the title, "Lungs for Industry."—*General Blower Company, Morton Grove, Illinois*.....**206**

Convector Radiator

A 16-page 2-color catalog describes latest molds of the Richvor cast iron convector radiator with installation drawings and photographs and rating tables.—*Richmond Radiator Co., Uniontown, Pa*.....**207**

Automatic Controls

A 52-page catalog, 52C, giving engineering data on General Controls' line of automatic pressure, temperature and flow controls for gas, oil, air, water, steam, refrigerants and other fluids for domestic, industrial, refrigeration and aircraft use.—*General Controls Co., 801 Allen Avenue, Glendale, Calif.* **208**

Controlled Heat

The Moduflow system of controlled heat, where heat supply is continuous but modulated, is described in an 8-page bulletin. System can be applied to most heating systems and to all fuels.—*Minneapolis-Honeywell Regulator Co., Minneapolis 8, Minn.* **209**

Filters

An 8-page bulletin in two colors, describes the Air-Maze line of filters for air and oil, with construction details, special applications, and type varieties.—*Air-Maze Corporation, 5200 Harvard Avenue, Cleveland 5, Ohio*.....**210**

Cargo Protecting System

The Cargocaire system for control of humidity in ship holds and protection of cargoes is described in an 8-page folder. The system is said to keep dewpoint at safe level automatically by simple dehumidification and ventilation. — *Cargocaire Engineering Corp., 15 Park Row, New York 7, N. Y.*.....211

Extended Surface Radiation

Bulletin B 1550A, 8 pages, describes and illustrates construction details of Webster type WI extended surface radiation and includes details on brackets, adapters, covers, and accessories. Installation diagrams and ratings are presented.—*Warren Webster & Co., Camden, New Jersey.* 212

Industrial Furnaces

Direct-fired, hot gas generating; industrial furnaces with capacities from 60,000 to 100 million Btu for process drying and product heating are described in a 12-page bulletin.—*Air Devices, Inc., 17 E. 42nd St., New York 17, N. Y.*.....213

Positive Displacement Meters

Positive displacement meters are the subject of Bulletin 40-B-14, a 16 page, 2 color booklet, illustrated with sectional drawings and installation views. Meters are built for pressure of 25, 50 and 125 pounds in standards sizes and steel encased meters for line pressures of 300 lb upward are also available; 39 meter sizes are listed. — *Roots-Connersville Blower Corp., 900 West Mount St., Connersville, Ind.* 214

Heating Equipment

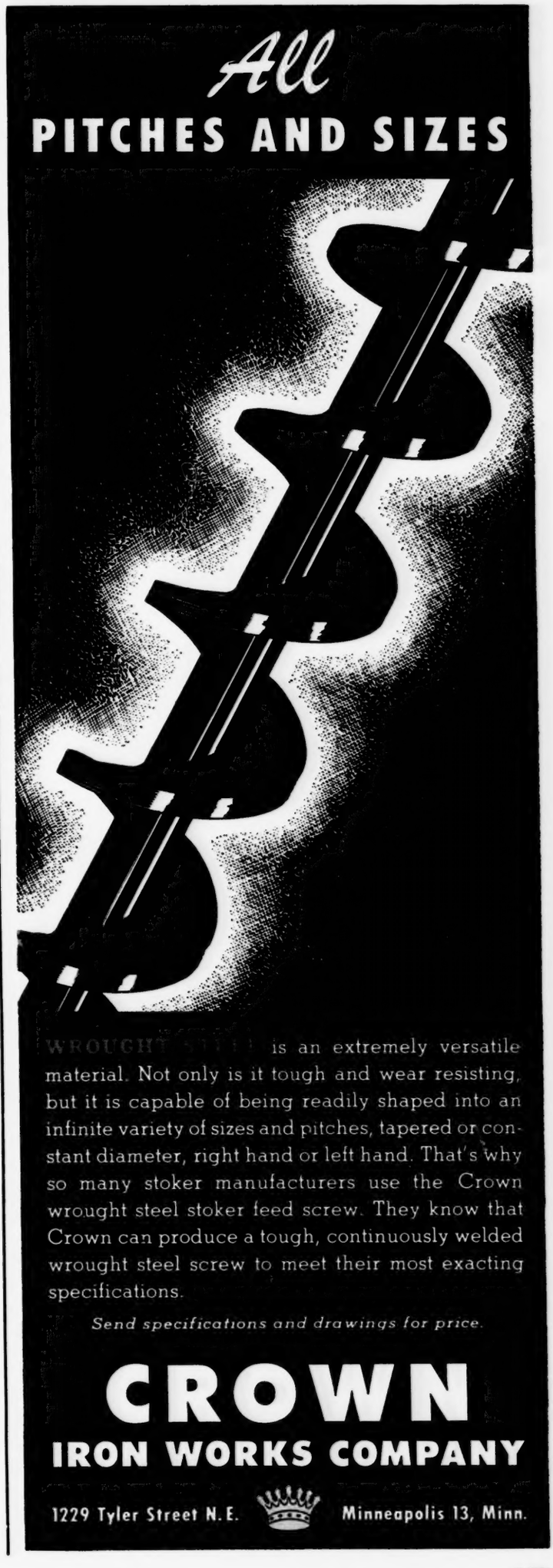
A 6-page illustrated folder on gas-fired heating equipment describes in detail new 1947 model conversion burners, new gravity furnaces, winter air conditioners, boilers, hot water heaters and unit heaters. The folder emphasizes the Norman improved principle of burning gas.—*Norman Products Co., 1150 Chesapeake Ave., Columbus 8, Ohio.* 215

Trade School

A new pictorial booklet, "Learn Arc Welding," outlines the functions and courses of study pursued at the Hobart Trade School in a 24 page publication which may be obtained free of charge by writing the registrar of the school. —*The Hobart Trade School, Inc., Troy, Ohio.* 216

Valves

A cloth bound, 236-page general catalog and data book describes gate, globe, angle, check and marine valves in ferrous and non-ferrous materials. Includes sections on valve accessories, parts, and engineering data.—*Ohio Injector Co., Wadsworth, Ohio.* 217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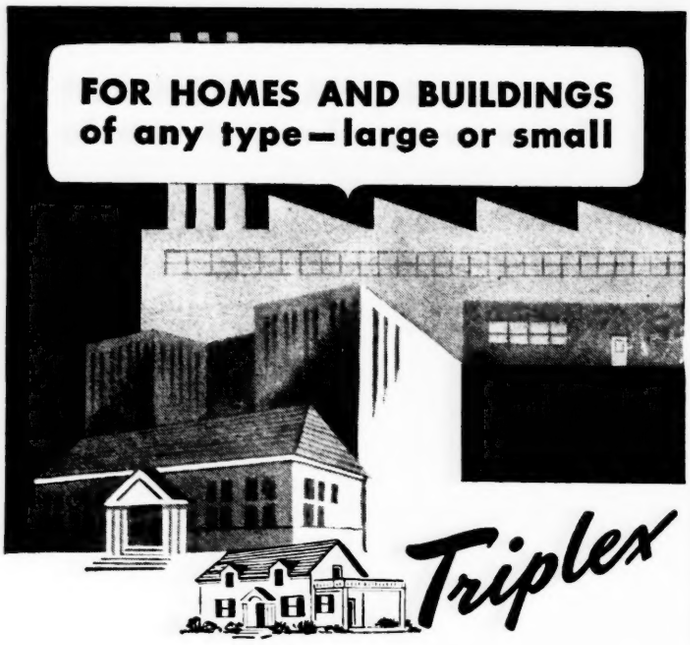

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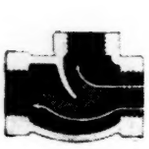
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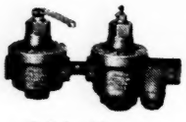
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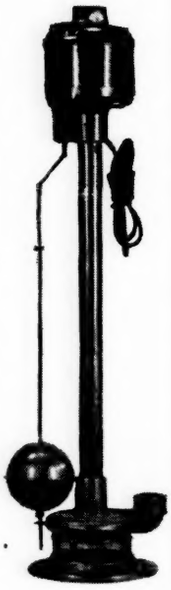
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Air Recovery Bulletin

Bulletin 106-A, "Dorex Activated Carbon Air Recovery Panels," contains complete data on the design, construction, function and application of these units. The bulletin shows performance chart which provides data necessary for proper panel section. Capacities at various resistances, fresh air percentages and approximate hours of service life are shown for each type, size, and series of panel.—*W. B. Connor Engineering Corp., 114 E. 32nd St., New York 16, N. Y.*.....218

Series on Pumps

A series of seven new bulletins describes The Byron Jackson line of pumps. Featured in separate bulletins in the series are: VMT pumps, centrifugal pumps, submersible pumps, the double volute feature of centrifugal pumps, bulk station pumps, hydropress pumps, and general types of pumps included in the line.—*Byron Jackson Co., P. O. Box 2017, Terminal Annex, Los Angeles 54, Calif.* 219

Industrial Heat Enclosures

A 32-page, 3-color booklet features "suspended" refractory walls made from standardized shapes which allow for expansion and are said to reduce spalling. Booklet presents design, installation, and maintenance data and illustrations.—*Geo. P. Reintjes Co., 2517-19 Jefferson St., Kansas City, Mo.* 220

Venturi Radiator Fittings

"Taco-One" Venturi fittings and Hy-Duty circulator pumps for one pipe hot water heating systems are described in a 4-page bulletin.—*Taco Heaters, Inc., 342 Madison Ave., New York, N. Y.* 221

Natural Hair Filter

A 4-page bulletin describes throwaway air filters made with natural hair, with charts pointing out the advantages and performance of this type of packing.—*Wilson & Co., Inc., Air Filter Div., 4100 S. Ashland Ave., Chicago, Ill.* 222

Pressure Reducing Valves

Bulletin 199, 4 pages, 2 colors, features pressure reducing valves developed to fit special installations. The line includes standard types and offers special designs for unusual requirements.—*A. W. Cash Valve Mfg. Corp., 666 East Wabash Avenue, Decatur 60, Illinois*.....223

Roof Cooling Spray Systems

A 4-page, 2-color folder describes a patented, automatic spray system for roof cooling said to maintain a roof temperature of 73 to 90F under full sun exposure.—*April Showers Co., 4126 Eighth St. N. W., Washington, D. C.* 224

Pump Governors

Bulletin 463—a new 16-page illustrated booklet gives engineering, operating and maintenance data on pump governors for control of reciprocating, turbine and motor driven pumps. Construction details of each class of bronze and steel governor are shown in cross-sectional color views. Both constant pressure and excess pressure pump governors are featured. Included also are capacity tables, specifications, sizing information, installation and operation instructions with photographs, including recommended procedures for dismantling, cleaning and assemblying, are also given.—*Leslie Co., 52 Delafield Ave., Lyndhurst, N. J.*.....225

High Velocity Air Filters

A 12-page bulletin, two colors, describes the permanent, cleanable, high velocity Agitair "FM" filters for warm air heating, air conditioning and ventilating systems. Includes tables of test results, installation photographs, and diagrams.—*Air Devices, Inc., 17 E. 42nd St., New York 17, N. Y.*.....226

Pipe Line Filters

A 4-page bulletin in two colors, gives construction diagrams and specifications of the Air-Maze type PL pipe line filters for removing water, oil, dirt, and scale from compressed air or gas lines, under pressures up to 150 pounds gage.—*Air-Maze Corp., 5200 Harvard Ave., Cleveland 5, Ohio.* 227

Unit Heaters

Series 12 and 15 unit heater catalogs describe horizontal units ranging from 100 to 1000 EDR capacities and downblow units from 500 to 1800 EDR. These are post-war units with copper tubes and fins.—*Fedders-Quigan Corporation, 57 Tonawanda Street, Buffalo, N. Y.* 228

MARCH, 1947

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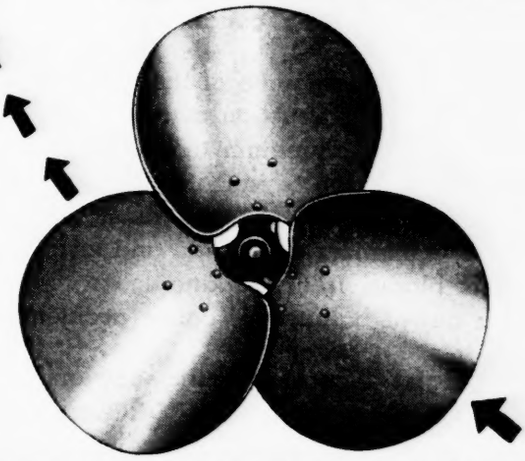

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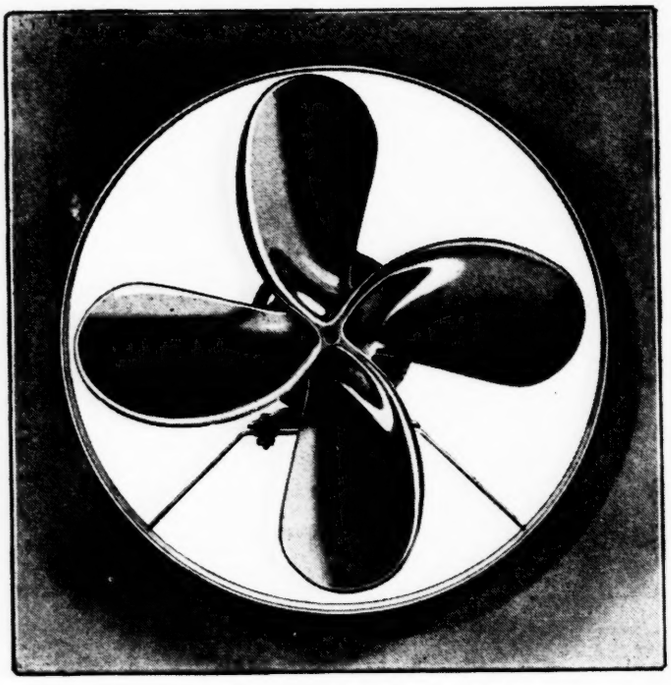

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EDITOR, HEATING AND VENTILATING:

The Heating Branch of the Air Installations Section, Tactical Air Command, Langley Field, Virginia, has a vacancy for a qualified heating engineer. This position is classified under Civil Service and carries a yearly salary ranging from $4,902.00 to $6,862.80.

The person to fill this position should preferably be an engineering graduate with a broad background of experience in all phases of heating engineering. The work involves technical supervision of design, construction and maintenance of individual and central heating plants located at Tactical Air Command stations. Occasional travel is involved for which a per diem allowance of $6.00 per day is authorized for duty away from Langeley Field.

Applicants for this position should submit a Civil Service Form No. 57 which may be secured from any Post Office or Civil Service Representative.

Inasmuch as no funds are available for paid advertisements of this nature, it would be considered a distinct favor if you could arrange to give this matter publicity in your publication.

Walter A. Faiks, Lt. Colonel, C. E., Executive Officer, Headquarters Tactical Air Command.
Langley Field, Va.

EDITOR'S NOTE: Applications for two New York City civil service positions are open March 5 to 20 as follows: (1) Inspector of Water Consumption, Grade 2; salary, $1,801 to $2,400 per year; (2) Jr. Mechanical Engineer; salary, $2,160 to $3,120; must be engineering graduate, no experience necessary. Cost of living bonus of $660 is in addition to above salaries.—*Municipal Civil Service Commission, 96 Duane St., New York 7, N. Y.*

Getting Personal

C. J. Schwarzer

C. J. Schwarzer (*Motor Starting and Control*, page 60) enrolled for the Westinghouse graduate student course following receipt of his B. S. degree in General Engineering from Iowa State College in 1928. During his graduate course he was with the large motor sales section and he specialized in synchronous motor applications. In 1930 he transferred to Westinghouse's Chicago office.

He continued further training as a sales assistant until 1932 in preparation for work as an application engineer of the Machinery Electrification Section. From 1932 to 1941 he was interested in pumps and compressors as applied to the air conditioning industry. For the next five years he was engaged in the application of electrical apparatus in the mining industry.

Mr. Schwarzer transferred in 1945 to the East Pittsburgh works in the Machinery Electrification Section, Industry Sales dealing with manufacturers of pumps, compressors, fans, and allied products applicable to air conditioning.

. . . Since the Last Issue

E. W. Haefner

E. W. Haefner has been appointed an assistant general sales manager of the **Airtemp Division of Chrysler Corp.** Until his appointment, Mr. Haefner served as manager of the parts and service department. In his new position, he will supervise the mechandising, sales records, order, application and parts and service departments. Mr. Haefner, who served one year with the Army in World War I and three years in World War II, joined the Airtemp Division in 1939. He came to Dayton from the Central Service Division at Detroit. He joined Chrysler in 1936.

Charles S. Redding, president of **Leeds & Northrup Co.,** manufacturers of electrical measuring instruments and heat treating furnaces, received the honorary degree of Doctor of Science at the mid-winter commencement exercises of the University of Pennsylvania Feb. 15.

Hendrick Mfg. Co., Carbondale, Pa., perforated and fabricated metal producer, has appointed **Robert F. Vandenberg** as its district sales representative in New York State. Mr. Vandenberg, who is a graduate of Lafayette College and was recently released from the Navy, will make his headquarters in the home office at Carbondale and will represent Hendrick in the entire state with the exception of the territory adjacent to New York City.

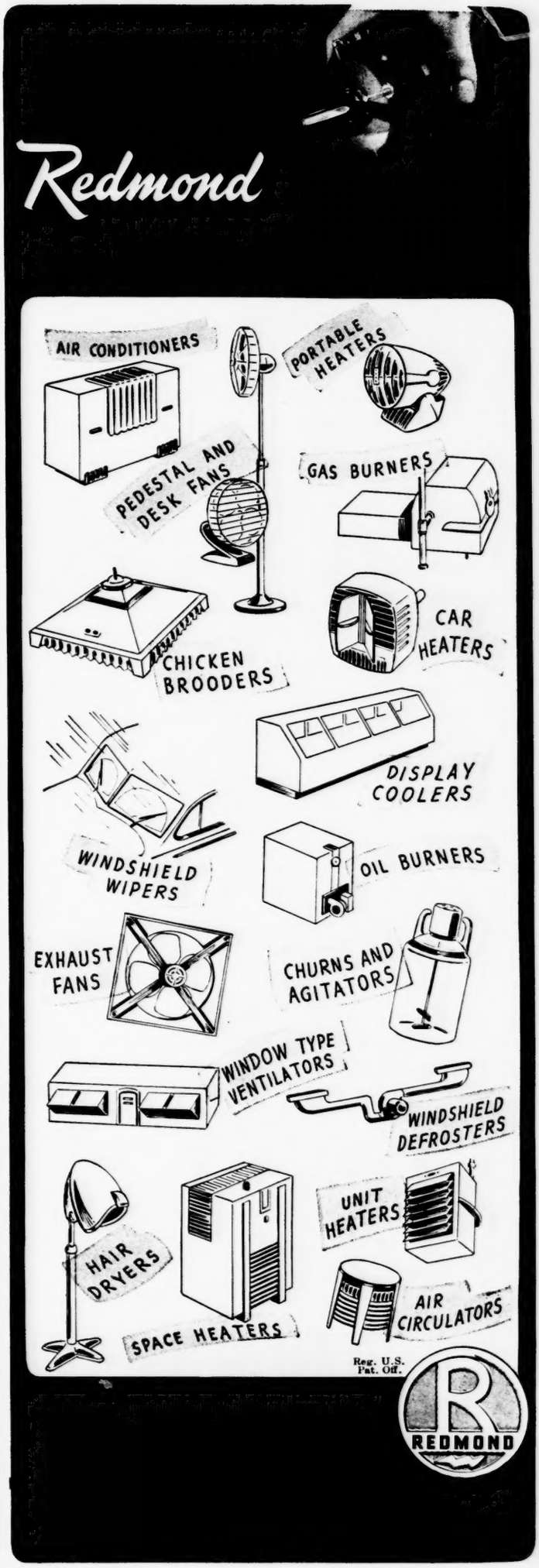
Two training schools, one offering courses in air conditioning and one covering commercial refrigeration, have been inaugurated by the **General Electric Company's** air conditioning department in Bloomfield to bring engineers of the company's distributors up-to-date on advanced refrigeration and air conditioning techniques through intensive three week courses. The courses will be continuous through the year, the refrigeration school alternating every three weeks with the air conditioning school.

General Controls Co. announces the appointment of **E. B. Maire,** as regional sales manager of their mid-western, southern and eastern branch office territories: Boston, New York, Philadelphia, Pittsburgh, Detroit, Cleveland, Atlanta and Chicago.

J. H. Winters

J. H. Winters has been promoted to eastern divisional manager of the **Airtemp Division, Chrysler Corp.** Mr. Winters will have charge of the Boston, Syracuse, New York, Philadelphia and Washington regions. Mr. Winters joined the Airtemp Division in April, 1945, as a district representative in the Dayton region. In September, 1945, he was appointed district coordinator of the Kansas City region. Later, he was named as staff assistant to the vice-president and general sales manager. Mr. Winters, a graduate of Yale University, will maintain divisional headquarters in Dayton.

Appointment of **Frederick C. Brandt** as sales manager of the air conditioning controls division for the **Minneapolis-Honeywell Regulator Co.** in the southwestern region has been announced. Mr. Brandt will make his headquarters in Houston at the company's regional office, 1309 Capitol Avenue.



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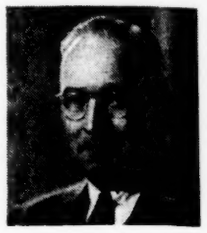
YARNALL-WARING CO., 104 Mermaid Ave., Phila. 18, Pa.

Hoffman Specialty Co. announces that effective March 1st, **Edwin L. Malm** became assistant to Frank Gaylord, sales manager of the company. Mr. Malm is a graduate of the University of Michigan and a licensed engineer. Among his former business associations are nine years with American Radiator and seven years with Crane Co. For the last six years he has been sales promotion manager of the Bell & Gossett Co. Mr. Malm will make his headquarters at the home office of the Hoffman Specialty Co. at Indianapolis, Ind.



E. L. Malm

Martin E. Snyder has been appointed comptroller of **Consolidated Conditioning Corp.**, 26 West 47th St., New York City. Mr. Snyder came to Consolidated after twenty years with the Carrier Corp. of Syracuse, New York. In 1936 he was appointed Treasurer of Carrier and in 1940 Secretary Treasurer.

Tinnerman Products, Inc., Cleveland, Ohio has licensed **Shakeproof Inc., Division of Illinois Tool Works,** Chicago, to manufacture and market speed nuts and speed clips on which Tinnerman holds the patents. Shakeproof will go into production during the current quarter

Arthur McCutchan has been appointed senior research engineer of the product engineering and research department of **Tube Turns (Inc.)**, Louisville, Ky. Mr. McCutchan is a native of Alexis, Ill., and attended the University of Michigan. He was associated for twenty years with the engineering division of the Detroit Edison Co., specializing in the design of power plant piping, before joining Tube Turns. He is the author of numerous articles on piping flexibility, flange design, application of welding to high pressure-high temperature piping, and graphitization of high-temperature steam piping. And he is the co-author, with Sabin Crocker, of the chapter on Expansion and Flexibility in the Piping Handbook. He is a member of the Engineering Society of Detroit and the ASME.

A. McCutchan

The **Bryant Heater Co.** has established a graduate fellowship with a stipend of $1,850 for study at **Case School of Applied Science**, Cleveland, Ohio, according to an announcement by Dr. Elmer Hutchisson, Dean of the Graduate Division. This fellowship is open to graduates with the degree of Bachelor of Science in Mechanical Engineering. It is expected that the fellow's thesis will be concerned with gaseous fuels or some other fundamental problem of interest to the gas industry.

J. J. Mellon, who has been associated with the **Allen-Bradley Co.**, Milwaukee, Wis., for the past two years, has been appointed chief engineer of that company. Mr. Mellon has been active in the development of industrial electric control equipment since his graduation from Rensselaer Polytechnic Institute in 1923. He has held important engineering and executive positions with Westinghouse, and Clark Controller Co., and during the past two decades has been active on the engineering and advisory committees of the Industrial Control Section of the National Electrical Manufacturers Association.

J. J. Mellon

The Marley Co., Inc. of Kansas City, Kans., manufacturers of spray nozzles, cooling towers, and other water cooling equipment, announces the opening of a Los Angeles office at 303 Continental Bldg., 408 S. Spring St. **Arthur C. Elias,** factory engineer, supervised the opening of the branch office during the latter part of January. Mr. Elias entered the Kansas City office of the Marley Co. in August, 1946, after 3 years service as an officer with the Navy. He received his B.S. in chemical engineering from Worcester Polytechnic Institute at Worcester, Mass. in February, 1944.

A. C. Elias

Following a recent meeting of the board of directors of **Curtis Mfg. Co.,** 1905 Kienlen Avenue, St. Louis, it was announced that **John D. Lodwick** had been elected vice-president in charge of sales of the pneumatic division, and that **Harry C. Morrison** had been elected vice-president in charge of sales of the refrigeration division of the company.

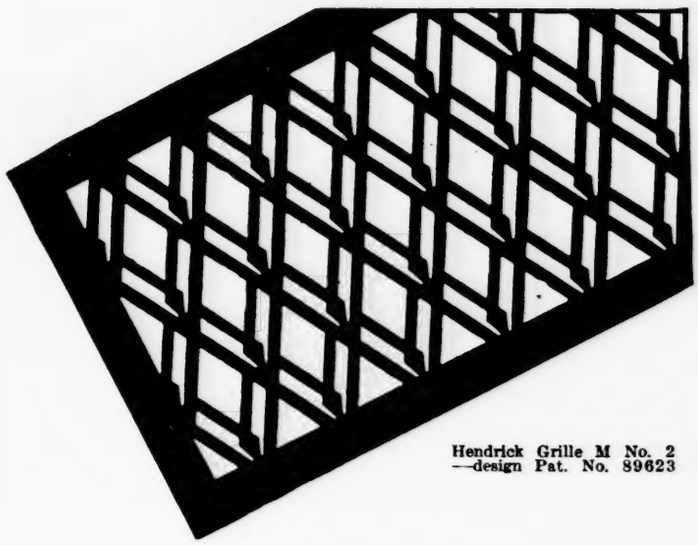
Consolidated Industries, Inc., manufacturers of automatic heating and low temperature freezing products, of Lafayette, Indiana, announced the appointment of **W. W. Timmis** as general sales manager. Mr. Timmis, one of the most widely known executives in the heating and air conditioning industry, served as director of the metal products division of the National Housing Agency, a position he was invited to fill because of his comprehensive experience with the plumbing and heating division of the W.P.B., of which he was appointed director in the early part of 1942. Prior to his war-time experience, Mr. Timmis had almost 20 years in the heating and air conditioning industry, serving as manager of M. E. Conran Co., and manager of C. A. Dunham Co., in the New York office. From 1932 to 1938, Mr. Timmis was manager of air conditioning systems and controls division of the American Radiator Co. In 1938 he became president of Air-Temp-Co and then organized Herke & Timmis, Inc., of New York City, manufacturers and distributors of temperature controls.

W. W. Timmis

William T. Reid, for seventeen years associated with the U. S. Bureau of Mines, has joined the staff of **Battelle Institute,** Columbus, Ohio, where he will be engaged in the supervision of research in fuels and combustion.

Lynn H. Johnson has been appointed sales manager of the gas controls division of **Minneapolis-Honeywell Regulator Co.** Joining the company in 1933 as a member of the production department, Mr. Johnson was later transferred to the sales department in the company's central region where he served until joining the U. S. Army in 1942. A graduate of Officers Training School, he rose to rank of captain in the Ordnance department. He rejoined Honeywell after the war and was assigned to the Cleveland office as assistant to the regional manager, a position he held until his latest promotion. In his new assignment, Johnson will serve under C. D. Lyford, vice-president in charge of the gas controls division.

L. H. Johnson



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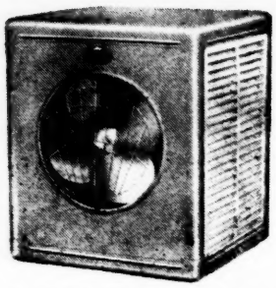

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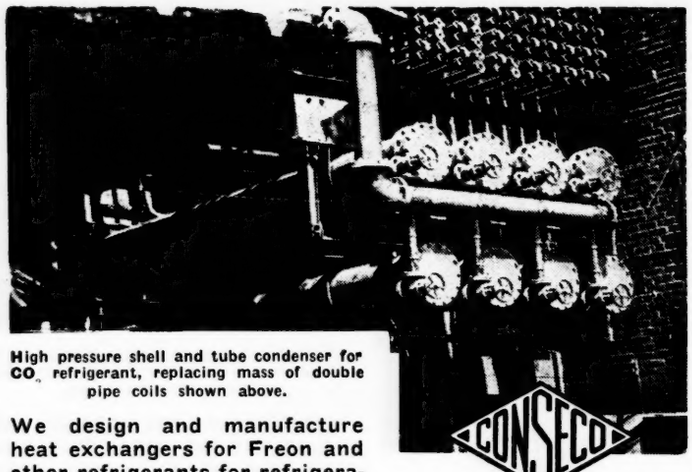

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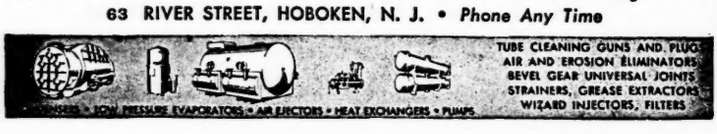
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Dravo Corp., Pittsburgh, has announced the appointment of **D. R. Berg** as manager of the heating and combustion sections of the firm's Machinery Division. The heating section manufactures and markets nationally the Dravo Counterflo oil or gas-fired heater for industrial and commercial use, and the combustion section furnishes and installs in Western Pennsylvania, Iron Fireman stokers, Cleaver-Brooks boilers, Todd oil burners, Whirlex fly-ash arrestors and other combustion equipment. A graduate of Lehigh University, Mr. Berg first joined Dravo in 1938 and has held several supervisory positions, including assistant general mechanical superintendent and outfit superintendent of Dravo's Neville Island shipyard and administrative manager of the Wilmington, Delaware, shipyard.

D. R. Berg

An electric weld tube mill is now being installed by the **Wheatland Tube Co.** The mill, built by the Yoder Co. of Cleveland, Ohio, will be housed in the expanded wing of the modern Wheatland plant at Wheatland, Mercer County, Pennsylvania. The project is nearing completion, and it is expected that it will be in production some time in the second quarter of this year.

The establishment in Clearwater, Florida, and Jamestown, New York, of two new representatives for the **Bryant Heater Co.** is announced. In Jamestown, **Philip W. McCoy** has established the **Bryant-McCoy Co.** at 10th and Monroe Streets. Mr. McCoy, a graduate of Carnegie Institute of Technology, has been engaged in the design and development of domestic heating equipment since 1927. The **Bryant-Schaack Co.** has been established at 1011 Pine Brook Drive in Clearwater, Florida, by **Paul J. Schaack**, who has been with Bryant Heater since 1934, in Cleveland and in Pittsburgh. A graduate in mechanical engineering of Rose Polytechnic Institute, he served during the war years as assistant to the director of the Plumbing and Heating Division of the WPB.

The **Sporlan Valve Co.** of St. Louis announces the opening of new sales offices in Dallas, Texas, and Philadelphia, Pennsylvania. The new southwestern division office at Dallas will be supervised by **P. J. McCarty. T. H. Silary** will have headquarters in Philadelphia. **J. T. Barry** has been brought back to St. Louis after spending three years in the eastern district office at New York City. He is being replaced in New York by **A. L. Javes**, a new man with Sporlan, who will cover the New England States.

L. M. Morley has been elected a vice-president of the **Minneapolis-Honeywell Regulator Co.** Mr. Morley, vice-president in charge of sales for the Brown Instrument Co., a wholly-owned Honeywell subsidiary at Philadelphia, will continue to supervise sales of the industrial control devices made by the Brown division, His newest promotion thus makes him an officer of the parent company as well as its subsidiary. A graduate of the University of Pennsylvania, Mr. Morley joined the Brown Instrument Company in 1919 as a salesman. He was made sales manager in 1934 and became a vice-president in 1935 when Brown and Minneapolis-Honeywell were merged to form the present corporation. He served in this capacity until his latest promotion.

L. M. Morley

S. R. Williams

The board of directors of **Worthington Pump and Machinery Corp.** at its January meeting, elected **S. Riley Williams** vice-president in charge of foreign business. Mr. Williams joined the Worthington organization in 1920, immediately following his release from the United States Army, where he served as a first lieutenant in World War I. From 1920 until 1941 he resided in Europe, where he was successively managing director of the Worthington associated company in Spain, of its associated company in France, and general European manager. In 1941 he returned to the United States, and during the recent war served as assistant to the vice-president in charge of operations. In May 1945 he was appointed director of international business.

INDUSTRIAL DEGREE-DAYS
January, 1947

City	55F Base	45F Base
Baltimore, Md.	423	171
Buffalo, N. Y.	777	467
Chicago, Ill.	742	434
Cleveland, Ohio	688	386
Detroit, Mich.	795	486
Indianapolis, Ind.	616	331
New York, N. Y.	555	271
Philadelphia, Pa.	472	212
Pittsburgh, Pa.	582	300
St. Louis, Mo.	546	284

CANADIAN DEGREE-DAYS FOR JANUARY, 1947*

City	January 1947	January Normal	Cumulative, Sept. 1 to Jan. 31 1946-47	Cumulative, Sept. 1 to Jan. 31 Normal
Calgary, Alta.	1420	1609	5512	5311
Charlottetown, P. E. I.	1432	1463	4157	4328
Crescent Valley, B. C.	1321	1352	4685	4631
Edmonton, Alta.	1674	1814	6177	5798
Fort William, Ont.	1711	1807	5628	5622
Grand Prairie, Alta.	1823	1841	6597	6000
Halifax, N. S.	1230	1283	3637	3898
London, Ont.	1206	1336	3586	4013
Medicine Hat, Alta.	1442	1643	5402	5032
Moncton, N. B.	1494	1528	4429	4714
Montreal, P. Q.	1513	1552	4333	4648
North Bay, Ont.	1705	1658	5062	5161
Ottawa, Ont.	1590	1646	4561	4923
Penticton, B. C.	1224	1184	4115	3810
Porquis Junction, Ont.	1876	2052	5827	6300
Prince George, B. C.	1716	1615	5625	5372
Quebec City, P. Q.	1606	1696	4711	5207
Regina, Sask.	1860	2037	6587	6373
St. John, N. B.	1345	1417	3985	4386
Saskatoon, Sask.	1860	2027	6681	6276
Toronto, Ont.	1170	1304	3413	3948
Vancouver, B. C.	998	893	3401	3061
Victoria, B. C.	862	815	2048	2725
Windsor, Ont.	1116	1283	3185	3729
Winnipeg, Man.	1804	2111	6172	6316

*These data are supplied through the courtesy of the Meteorological Division, Air Services Branch, Department of Transport, Canada, with the cooperation of N. W. Etter, Heating Engineer, Enamel & Heating Products Limited, Sackville, N. B.

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- EVALUATION OF SHAPE FACTOR: APPROXIMATIONS AND EXAMPLES
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